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New and little-known species of *Microchaetus* Rapp, 1849, with a key to all species and notes on the significance of certain morphological features (Oligochaeta: Microchaetidae)

by

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ABSTRACT

Fourteen new species of *Microchaetus* are described and illustrated, and additional information is given for some previously known species. The following thirteen new species are holandric: *alipentus, ambitus, circulatus, davidi, hamerae, imitatus, obscurus, occidualis, occiduus, pauli, pentus, senarius* and *tuberosus; metandrus* sp. n. is the first species in the genus with metandric characters. Type material of three species described by Pickford (1975) – *guntheri, ljungströmi* and *pearsonianus* is examined. New localities for *M. natalensis* (Kinberg, 1867), *M. papillatus* Benham, 1892, *M. parvus* Michaelsen, 1913, *M. pondoanus* Michaelsen, 1913, *M. vernoni* Plisko, 1992 and *M. zaloumisi* Plisko, 1992, are recorded.

A reduction of one pair of seminal vesicles in four species is noted (anterior pair in *metandrus* and *pearsonianus,* posterior pair in *alipentus* and *pauli*). Backward extension of either the anterior or the posterior pair of seminal vesicles observed in 13 species is discussed. Certain combinations of character states, distinguishing some clusters of species, are revealed. Some morphological characters are linked with their geographical distribution.

A key to the known *Microchaetus* species is provided. A distribution of species is mapped.

The prior record of parasitic larvae of Diptera in Microchaetidae is reported; such larvae were found in anterior segments of a specimen of *M. parvus* Michaelsen, 1913.

INTRODUCTION

Progressive advances in the classification of earthworms in the endemic South African family Microchaetidae (Plisko 1992 1993*a,b* 1996 1997) have resulted in the recognition of four genera. The original genus *Microchaetus* Rapp, 1849, is now restricted to 40 holandric and 1 metandric species, following the segregation of 33 proandric species in a separate genus *Proandricus* Plisko, 1992. Other microchaetids fall mostly in the genus *Tritogenia* Kinberg, 1867, of which 31 species are currently known (Plisko 1997). The distinctive genus *Michalakus* Plisko, 1996, is presently monotypic.

As a result of recent fieldwork in the SW Cape and Namaqualand, several new species of *Microchaetus* were discovered; further undescribed species from KwaZulu-Natal have also been identified. These are described below, and a key is provided for all known species of the genus.

In this paper the species are dealt with in alphabetic order for easy reference. As supplements to the key and possible indicators of relationships within *Microchaetus*, three tables are presented. The occurrence of particular character states is given in Table 1 and Table 2. Certain combinations of character states distinguishing some clusters of species, which are restricted to particular regions of South Africa, is provided in Table 3.

MATERIAL AND METHODS

The material described is mainly in the Oligochaeta Collection of the Natal Museum. Specimens of some previously described species were borrowed from the South African Museum, Cape Town. The type material housed in the Natal Museum was re-examined, and compared with new material. Descriptions are based on preserved material, apart from data relating to the colour and measurement of living specimens, if such data were recorded at the time of collection. Studies of internal anatomy were done through dorsal dissections. Photographs were taken using a WILD photomicroscope. Co-ordinates are provided in brackets for all place names recorded on the original labels. The names of provinces of the Republic of South Africa presently in use are listed below; where these differ from names used before 1994, the original names are given in the right-hand column.

Glossary and abbreviations:

BRS	B. R. Stuckenberg
Eastern Cape	Eastern Cape Province
JDP	J. D. Plisko
KwaZulu-Natal	Natal Province
Mpumalanga	South-eastern Transvaal
NMSA	Natal Museum, Pietermaritzburg, South Africa
NMSA/Olig.	Oligochaeta Collection, Natal Museum
Northern Cape	Northern Cape Province
Northern Province	Northern Transvaal
SAM	South African Museum, Cape Town, South Africa
TL	T. Liversage
Western Cape	South-western Cape Province
u	abbreviation of German word '*Umfang*' meaning circumference of body

1/n followed by a number, means part of that segment indicated by the number.

TAXONOMY

Key to genera of Microchaetidae

1 One oesophageal gizzard.....2
– Two oesophageal gizzards, one in 7 extending into 6, second in 9.....**Michalakus**

2 One pair of nephridia per segment.....3
– More than one pair of nephridia per segment.....**Tritogenia**

3 Holandric or metandric.....**Microchaetus**
– Proandric.....**Proandricus**

Microchaetus Rapp, 1849

Type species: *Lumbricus microchaetus* Rapp, 1849, by monotypy.

Diagnosis: Preclitellar segments with external annulation present. Segments 1 and 2 fused or separated. Eight small setae per segment, paired. Distance between *dd* setae equal to ½ u or shorter. Male pores intraclitellar. Spermathecal pores anterior to male

pores. One oesophageal gizzard in segment 7. Calciferous glands paired or encircling oesophagus. Typhlosole present. Dorsal blood vessel in some preclitellar segments undivided or double. Oesophageal vessel present. Nephridia, one pair per segment: meganephridia, with coiled loops and various shapes of caeca. Holandric (testes and spermiductal funnels in segments 10 and 11) or metandric (with testes and spermiductal funnels in segment 11). Spermathecae paired or multiple, variable in number, shape and size. Seminal vesicles confined to single segment, or extended backward over 2 or more segments. Papillae present or absent. Genital glands of various sizes and shapes present, or absent.

Terrestrial, living in soils of natural biotopes undisturbed by agriculture or industry, and prefering primary grasslands, savannahs, natural forests, and riparian sites. Some species (*parvus, papillatus, natalensis*) were collected also from pastures or partly utilised land, where soil was not much disturbed (sports fields, lawns, ornamental gardens).

Endemic to South Africa, including Swaziland and possibly with limited extension into Mozambique. The genus occurs in many parts of South Africa, but very few of the 41 known species have been found to be wide-ranging.

Key to the species of *Microchaetus* Rapp, 1849

1 Testes and spermiductal funnels with holandric arrangement (in segments 10 and 11) 2

– Testes and spermiductal funnels in metandric arrangement (commencing at septum 11/12); calciferous glands paired, clearly separated dorsally and ventrally; clitellum on 13–22; tubercula pubertatis on 17–20; spermathecal pores in 3 intersegmental furrows 13/14 14/15 15/16; one pair spermathecae per segment; male pores on segment 18 or in intersegmental furrow 18/19 ..... **metandrus** sp. n.

2 Calciferous glands encircle oesophagus 3

– Calciferous glands paired, clearly separated ventrally and dorsally 17

3 Spermathecal pores in 2 or 3 intersegmental furrows 4

– Spermathecal pores in 4, 5 or 6 intersegmental furrows 9

4 Spermathecal pores in 2 intersegmental furrows (12/13 13/14); 2 pairs per segment of tubular, bent or serpentine spermathecae; clitellum on segments 12–25; tubercula pubertatis on 1/n15–1/n20 ..... **ambitus** sp. n.

– Spermathecal pores in 3 intersegmental furrows 5

5 Spermathecal pores in 9/10 10/11 11/12; clitellum on 10–25,26; tubercula pubertatis on 17–23 ..... **namaensis** Michaelsen, 1908

– Spermathecal pores in 12/13 13/14 14/15 or 13/14 14/15 15/16 6

6 Spermathecal pores in 12/13 13/14 14/15 7

– Spermathecal pores in 13/14 14/15 15/16 8

7 Clitellum on 10–23; tubercula pubertatis on 19–24; mature specimens large (to about 1 metre long) ..... **decipiens** Michaelsen, 1899

– Clitellum on 12–30; tubercula pubertatis on 16–19,20; 2–3 spermathecae on each side, tubular, small, curved or looped; mature individuals extremely long (over 2 metres) ..... **vernoni** Plisko, 1992

8 Clitellum on 11–28,1/n29; tubercula pubertatis on 18–1/n23,23; spermathecae multiple, 1–5 on each side, minute, rounded; male pores in intersegmental furrow 20/21; anterior pair of seminal vesicles reduced; posterior pair bulging, extending backwards and forwards ..... **pearsonianus** Pickford, 1975

– Clitellum position uncertain; tubercula pubertatis on 18–28; spermathecae ovoid with long stalk, multiple, 1–3 at each side; male pores in intersegmental furrow 18/19; 2 pairs of seminal vesicles confined to segment 11 and 12 respectively ..... **guntheri** Pickford, 1975

9 Spermathecal pores in 4 intersegmental furrows 10

– Spermathecal pores in 5 or 6 intersegmental furrows 14

10 Spermathecal pores in 12/13 13/14 14/15 15/16 11

– Spermathecal pores in 13/14 14/15 15/16 16/17; spermathecae small, rounded, 1–2 per side; seminal vesicles confined to segments 11 and 12 respectively; clitellum on 14–23; tubercula pubertatis on 16–21; male pores in intersegmental furrow 18/19 ..... **crousi** Pickford, 1975

11 Posterior pair of seminal vesicles extending backwards 12

– Posterior pair of seminal vesicles not extending backwards 13

12 Clitellum on 13–23; tubercula pubertatis on 17–19; spermathecae moderate in size, round with slender, long necks, 1 pair per segment; male pores in segment 18 or 18/19 ..... **circulatus** sp. n.

– Clitellum on 15–24; tubercula pubertatis on 17–20; spermathecae pyriform, 1 pair per segment; male pores in segment 19/20 ..... **rosai** Michaelsen, 1908

13 Clitellum on 13–25,26; tubercula pubertatis on 18–25; spermathecae multiple, 1–4 at each side; mature individuals large (*ca.* 1 metre long) ..... **microchaetus** Rapp, 1849

– Clitellum on 10–30; tubercula pubertatis on 16–20; spermathecae multiple, 1–16 tiny ampullae, often deeply embedded in body wall; male pores in intersegmental furrow 17/18; mature individuals large (up to 90 cm long) ..... **papillatus** Benham, 1892

14 Spermathecal pores in 5 intersegmental furrows: 12/13 13/14 14/15 15/16 16/17 15

- Spermathecal pores in 6 intersegmental furrows 10/11 11/12 12/13 13/14 14/15 15/16 16

15 Clitellum on 12,13–24; tubercula pubertatis on 1–20; spermathecae multiple, 2–6 on each side, pyriform, small ..... **peringueyi** Michaelsen, 1913

– Clitellum on 10–30; tubercula pubertatis on 19–23; spermathecae multiple, 1–6 on each side, small, pyriform; male pores in 19/20; mature individuals large (*ca.* 80 cm) ..... **braunsi** Michaelsen, 1899

16 Clitellum on 10,11–28; tubercula pubertatis on 17,18–26,27; spermathecae: 1 pair per segment, elongate flask-shaped thecae; male pores in 20/21; 3 septa (4/5 5/6 6/7) thickened ..... **benhami** Rosa, 1891
– Clitellum on 11,12–27,28; tubercula pubertatis on 19–27; spermathecae tubular, bent or serpentine, 1 pair per segment; male pores in segment 20; 5 septa (4/5 5/6 6/7 7/8 8/9) thickened ..... **mkuzi** Plisko, 1992

17 Spermathecal pores in 1 or 2 intersegmental furrows 18
- Spermathecal pores in more than 2 intersegmental furrows 27

18 Spermathecal pores in 1 intersegmental furrow 19
– Spermathecal pores in 2 intersegmental furrows 20

19 Spermathecal pores in 12/13; clitellum on 12–19,20; tubercula pubertatis on 16–18; spermathecae tubular, moderate in size, twisted or bent, in groups, 3–5 at each side ..... **pondoanus** Michaelsen, 1913
– Spermathecal pores in 13/14; clitellum on 1/n13–20; tubercula pubertatis on 16–17,18; spermathecae small, oblong tubes, 5 pairs per segment ..... **zaloumisi** Plisko, 1992

20 Spermathecal pores in 11/12 12/13; clitellum on 10–24; tubercula pubertatis on 16–20; spermathecae minute, variously shaped, 3–5 on each side; 2 septa (7/8 8/9) very much thickened ..... **caementerii** Michaelsen, 1913
– Spermathecal pores in intersegmental furrows 12/13 13/14 or 13/14 14/15 21

21 Spermathecal pores in 12/13 13/14 22
– Spermathecal pores in 13/14 14/15 26

22 Clitellum occupies 9 or 10 segments 23
– Clitellum occupies more than 10 segments 24

23 Clitellum occupies 9 segments, on 12–20; tubercula pubertatis on 16–19; spermathecae moderate in size, tubular, bent or curved, 1–2 at each side; male pores in 14/15; 2 pairs seminal vesicles, each pair confined to segments 11 and 12 respectively ..... **montanus** Plisko, 1993
– Clitellum occupies 10 segments, on 13–22; tubercula pubertatis on 1/n14–18; spermathecae tubular, bent or curved, 1–2 pairs per segment; male pores in 14/15; seminal vesicles confined to segments 10 and 11 respectively, each pair enclosed in single sac ..... **tuberosus** sp. n.

24 Clitellum on segments 11,12–22,23; male pores in 14/15 or in 17/18 25
– Clitellum on 11–22; tubercula pubertatis on 17–20; male pores in 18/19; only septa 7/8 and 8/9 thickened moderately; spermathecae oblong, curved, 2 pairs per segment ..... **ritae** Plisko, 1993

25 Tubercula pubertatis on 16–19,20; male pores in 14/15; septum 5/6 not thickened; spermathecae shaped like claviform ampullae, 1 pair per segment ..... **rivus** Plisko, 1993

– Tubercula pubertatis on 15,16,17–19,20; male pores in 17/18; septum 5/6 very much thickened; spermathecae tubular, curved, 2 pairs per segment ..... **pentheri** Rosa, 1898

26 Clitellum on 12,13–21; tubercula pubertatis on 14,15–17,18; spermathecae pyriform, 1 pair per segment; mature individuals small (*ca.* 85 mm long, 2–3 mm wide)..... **parvus** Michaelsen, 1913

– Clitellum on 13–22; tubercula pubertatis on 15–18; spermathecae multiple, minute, tubular, with globular ectal end, 1–11 at each side; often deeply embedded in body wall; mature individuals moderate in size ..... **natalensis** (Kinberg, 1867)

27 Spermathecal pores in 3 or 4 intersegmental furrows 28

– Spermathecal pores in 5 or 6 intersegmental furrows 34

28 Spermathecal pores in 3 intersegmental furrows 29

– Spermathecal pores in 4 intersegmental furrows: 12/13 13/14 14/15 15/16..... 33

29 Spermathecal pores in 11/12 12/13 13/14; clitellum on 12–24,25; tubercula pubertatis on 1/n15,16–20,1/n21; spermathecae tubular, coiled or serpentine, 1–2 pairs per segment; male pores in 18/19 ..... **madidus** Plisko, 1993

– Spermathecal pores in 13/14 14/15 15/16..... 30

30 Spermathecae paired: 1 pair of large, ovoid or flask-shaped spermathecae per segment; tubercula pubertatis on 15–19; posterior pair of seminal vesicles extended posteriorly; septa 4/5 5/6 6/7 7/8 8/9 9/10 thickened..... **ljungströmi** Pickford, 1975

– Spermathecae multiple 31

31 Clitellum extends over 14 segments: 1/n13–26; tubercula pubertatis on 17–20,21; 1 to 5 pyriform spermathecae on each side; seminal vesicles confined to segments 11 and 12 respectively..... **franciscus** Pickford, 1975

– Clitellum extends over less than 14 segments..... 32

32 Clitellum extending over 11 or 12 segments: 12–22,23; tubercula on 17–19,20; 1 to 4 club- or flask-shaped, variably sized spermathecae; posterior pair of seminal vesicles extended backwards about to segment 23 ..... **occiduus** sp. n.

– Clitellum on 12–22; tubercula pubertatis on 17–20; 3 to 7 tiny, globular spermathecae at each side, often deeply embedded in body tissue; seminal vesicles confined to segments 11 and 12 respectively..... **occidualis** sp. n.

33 Clitellum on 12–22,23,24; tubercula pubertatis on 1n16–1/n20,20; spermathecae: 1 pair per segment, ovoid with long slender ducts; anterior pair of seminal vesicles confined to segment 11, posterior pair bulging, extending backward to segments 23,24..... **hamerae** sp. n.

– Clitellum on 12–24,24; tubercula pubertatis on 18–21; spermathecae: multiple, 1–4 at each side, ovoid with short slender ducts; seminal vesicles confined to segments 11 and 12 respectively..... **davidi** sp. n.

34 Spermathecal pores in 5 intersegmental furrows 35

– Spermathecal pores in 6 intersegmental furrows: 11/12 12/13 13/14 14/15 15/16 16/17; spermathecae multiple, tiny globular ampullae, deeply embedded in body tissue 39

35 Clitellum extends over 14 or fewer segments 36
– Clitellum extends over more than 14 segments 37

36 Clitellum on 12–25; tubercula pubertatis on 17–23; spermathecae multiple: 1–6 at each side, as tiny, globular bladders; anterior pair of seminal vesicles confined to segment 11, posterior pair extend backward to segment 15 ..... **pentus** sp. n.
– Clitellum on 12–24,25; tubercula pubertatis on 1/n17–1/n23; spermathecae multiple: 1–4 at each side, as tiny globular bladders; anterior pair of seminal vesicles extend backwards to segment 13; posterior pair reduced ..... **alipentus** sp. n.

37 Clitellum on 12–27,28; tubercula pubertatis on 17–24; spermathecae multiple: 1–6 at each side as minute, globular ampullae; seminal vesicles confined to 11 and 12 respectively, sometimes posterior pair extending backwards to segment 13; mature individuals moderate in size, with irregularly deposited tissue on clitellar segments ..... **obscurus** sp. n.
– Clitellum on 10–30; spermathecae multiple; seminal vesicles confined to segments 11 and 12 respectively; mature individuals very large (*ca.* 1 metre long) 38

38 Tubercula pubertatis on 18–22; spermathecae 2–16 at each side, minute, variable in shape; mature individuals large (to about 1 metre long) ..... **stuckenbergi** Plisko, 1991
– Tubercula pubertatis on 22–29; spermathecae 1–4 on each side, tubular, bent or serpentine; mature individuals large (to about 1 metre long) ..... **klopperi** Plisko, 1991

39 Clitellum on 11–28; tubercula pubertatis on 17–23,1/n24; 1–8 spermathecae on each side; posterior pair of seminal vesicles reduced; anterior pair well developed, extending backwards to about segments 15, 17 ..... **pauli** sp. n.
– Clitellum on 12–26 40

40 Tubercula pubertatis on 1/n17–24; 1–7 spermathecae at each side; 2 pairs seminal vesicles: anterior confined to segment 11, posterior to 12 or extended to 13 ..... **senarius** sp. n.
– Tubercula pubertatis on 17–23,24; 1–8 spermathecae on each side; 1 pair seminal vesicles, anterior pair reduced, posterior pair extends from segment 12 to 15 ..... **imitatus** sp. n.

Microchaetus alipentus sp. n.

Figs 1–2

Etymology: G. *alius* = other, *pente* = five. Species characterised by five rows of spermathecae, recorded also in *M. pentus*.

Material examined: **Western Cape**: *Holotype* NMSA/Olig.02644, clitellate, 7 km SE

Cirtusdal (32°36'S:19°01'E), rocky hillside near road R 303, 14 August 1997. Paratypes collected together with holotype: NMSA/Olig.02645, 4 clitellate; NMSA02601, 6 juveniles. All material collected by JDP &TL.

Description based on holotype and paratypes.

External characters:

General: Body cylindrical. *Colour*: In life dorsally dark violet-grey, ventrally grey; alcohol-preserved: dorsally dark violet, ventrally whitish-grey. *Dimensions*: Holotype in life, slightly stretched 260 mm long; preserved and contracted 200 mm long, 5 mm at 10, 6 mm at tubercula pubertatis; paratypes preserved 85–185 mm long, 4–5 mm wide at 10, 5–6 mm at tubercula pubertatis. *Segment number*: Holotype 417, paratypes 296–360. *Prostomium*: Prolobous, small, inverted into oral cavity. *Segmentation*: Secondary annulation present on preclitellar segments. Segments 1 and 2 fused, with no clear separation (Fig. 1), with irregular longitudinal grooves. Segment 3 simple, as long as 1 + 2; 4–7 with 2 simple ringlets similar in size and appearance; 8–9 with 2 irregularly annulated ringlets, second shorter than first; 10 and postclitellar segments simple; clitellar segments dorsally simple, ventrally with irregular annulation. *Setae*: Closely paired, minute; *ab* = *cd*; postclitellarly *aa* < *bc* < *dd*; *dd* < $\frac{1}{2}$u; first pairs of *ab* on 4. *Nephridial pores*: Small, more visible on clitellar segments; first pair in intersegmental furrow 3/4 much below *cd* setal lines. *Female pores*: On segment 14, above *ab* setae. *Male pores*: Probably in intersegmental furrow 18/19 or in posterior part of segment 18 in area of tubercula pubertatis, where small invaginations occur. *Spermathecal pores*: In 5 intersegmental furrows: 11/12 12/13 13/14 14/15 15/16 at clitellar ventral edges, close to nephridial pores.

Clitellar region: *Clitellum*: Saddle-shaped, segmented; in alcohol-preserved specimens whitish-grey; not clearly bordered anteriorly and posteriorly, however, after dissection the clitellar tissue can be observed in segments 12,13–24,25; ventral borders much below *cd* setal lines, just touching nephridial pores; clearly separated from tubercula pubertatis by narrow rims. *Tubercula pubertatis*: In preserved material shaped as flat glandular bands; oblong, rounded at corners, segmented, overlapping clitellum; on 1/n17–1/n23,23,24; dorsal edges below *b* setal lines, ventral at edges of clitellum; on holotype rounded by narrow rims; in incompletely developed paratypes the rims are not clear. *Papillae*: Paired swellings associated with *ab* seta; on 10–16 moderate, on 17–22 tiny; on 23–29 small, gradually diminishing in size.

Internal characters:

Septa: 4/5 5/6, 7/8 8/9 thickened moderately, slightly muscular, firm, similar in size and appearance; 6/7 and 9/10 thickened slightly, firm; other septa thin, firm. *Gizzard*: In 7, cylindrical. *Calciferous glands*: Dorsolateral, in 10; bulging against septum 10/11 to occupy partly segment 11; separated ventrally and dorsally. *Intestine*: Commences in 13. *Typhlosole*: Commences immediately with intestine as flattened W-shaped, gradually extending into thick, V-shaped; terminates in area of segment 225. *Dorsal blood vessel*: Undivided along whole length. *Paired dorsoventral vessels*: 4–8 thin tubes, sometimes demonstrating moniliform structure; 9–11 gradually enlarging, moniliform. *Oesophageal vessels*: Present. *Nephridia*:

Meganephridia; 1 pair per segment; tightly coiled tubules with elongated caeca turning dorsolaterally into J-shape (Fig. 2); shorter apical end of caeca reaches nephridial pores.

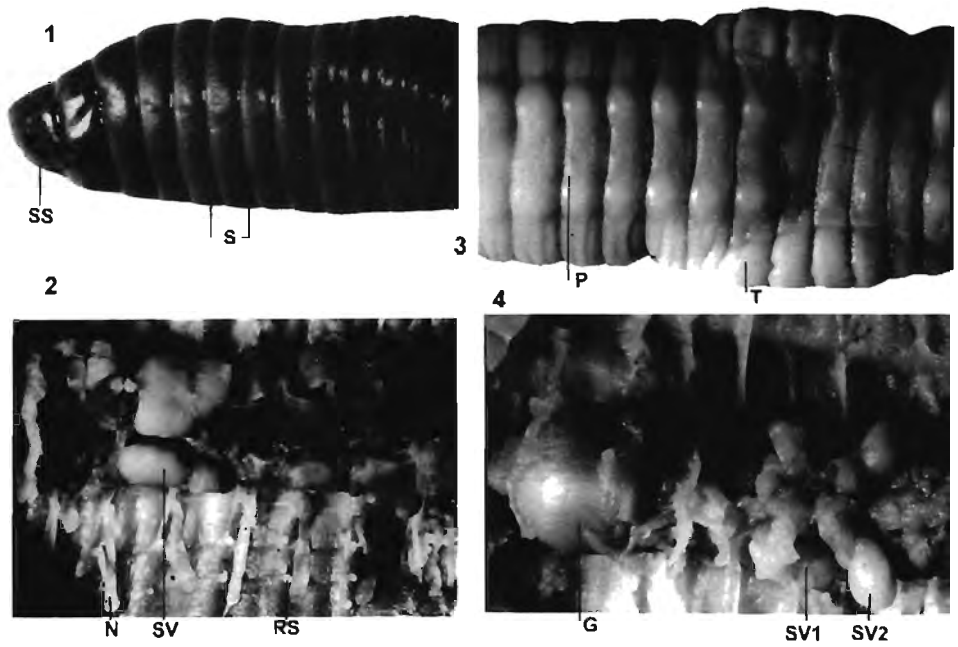
Reproductive organs: *Spermiductal funnels*: Holandric arrangement. Anterior pair usually much larger than posterior pair; in holotype and one dissected paratype the second pair was difficult to trace. Iridescence confirming presence of sperm was noted only in anterior pair. *Vasa deferentia*: On each side paired ducts commence on lateral side of spermiductal funnels, and extend transversely before curving posteriorly to run backward, parallel to axis of the body. Initially separated ducts of each pair, in area of segments 13–14, become close one to another, and finally unite in a single duct running to segment 18, where they enter body wall at 18/19, in area of male pores. *Seminal vesicles* (Fig. 2): A pair of small, lobular pouches commencing at septum 10/11, extending backward through septum 11/12 as a slender, irregular tubes which gradually enlarge into pouched vesicles projecting through segments 12,13,14. In holotype both vesicles are short, extending only to segment 13. In dissected paratypes they extend through segments 11–14. The second pair of seminal vesicles was not observed in holotype and paratypes. *Spermathecae*: In segments 12–16, near to septa 11/12–15/16. Tiny globular bladders of various sizes with thin necks embedded in body tissue (Fig. 2), 1–4 at each side. In holotype they were situated as follows: 11/12 = 1 + 0, 12/13 = 1 + 2, 13/14 = 2 + 3, 14/15 = 3 + 3, 15/16 = 3 + 3; in paratypes 1 + 1, 1 + 1, 3 + 3, 2 + 4, 4 + 2. *Ovaries*: Not observed. *Genital glands*: Various sizes, oval-shaped structures, associated with *ab* seta and corresponding with papillae. Moderate in 10–16, in 17–23 very small, in 24–29 slightly larger than those in 17–23, however smaller than in 10–16.

Biological notes: Found in dry rocky soil, under stones, and between roots of various plants covering a rocky hillside in the Cederberg range. Many juveniles found with mature specimens indicate development at the end of the rainy season. Associated with indigenous acanthodrilids.

Distribution: Known only from type locality in the Western Cape.

Discussion: Although this species is characterised by the reduction of a pair of seminal vesicles, it is still the most similar to my other new species *pentus*. Both species have the same general appearance, and have five rows of spermathecae, spermathecal pores in intersegmental furrows 11/12–15/16, and one pair of seminal vesicles extended backwards. In *alipentus* the posterior pair is reduced and the anterior pair is extended backwards. In *pentus* both pairs of seminal vesicles are developed, although the posterior pair is extended.

A similar reduction of the anterior or posterior pairs of seminal vesicles was also observed in *pauli, imitatus* and *pearsonianus*. *M. pauli* with six rows of multiple spermathecae has only one anterior pair of seminal vesicles, and this pair, as in *alipentus*, is extended backwards. In *imitatus* with six rows of multiple spermathecae, and *pearsonianus* with three rows, an anterior pair of seminal vesicles is reduced, and a posterior, well-developed pair extended backwards. All these species showing reduction of one pair of seminal vesicles are holandric, with paired spermiductal funnels and paired vasa deferentia.



Figs 1–4. *Microchaetus* species. 1–2. *M. alipentus* sp. n. 1. Anterior part of body, lateral view with fused segments 1 and 2, and annulated preclitellar segments. 2. Dorsally dissected preclitellar part of body. 3–4. *M. ambitus* sp. n. 3. Clitellar region, ventral view. 4. Dorsally dissected preclitellar part of body. [SS = fused segments 1 + 2; S = segment 5; N = nephridium of segment 12; RS = spermatheca of segment 14; SV = seminal vesicle; P = papilla; T = tuberculum pubertatis; G = gizzard; SV1 = anterior seminal vesicle; SV2 = posterior seminal vesicle.]

Microchaetus ambitus sp. n.

Figs 3–4

Etymology: L. *ambitus* = encircling. Refers to the calciferous glands encircling the oesophagus.

Material examined: **KwaZulu-Natal**: *Holotype* NMSA/Olig.00772, mature, abscised, Vernon Crookes Nature Reserve (30°18'S:30°40'E), 6 km N of Tourist Camp, primary grassland near the road, 22 November 1989, collected by JDP.

Description based on holotype.

External characters:

General: Body cylindrical, slightly flattened in clitellar area. *Colour*: Alcohol-preserved: yellowish-grey. *Dimensions*: Holotype abscised, somewhat contracted, 170+ mm long, 7 mm wide at 10, 10 mm at tubercula pubertatis. *Segment number*: Holotype 273+ segments. Following an indication of the position of typhlosole, the number of segments can be estimated at probably more than 400. *Prostomium*: Prolobous, small. *Segmentation*: Secondary and tertiary annulation present. Segments 1 and 2 simple, separated, each short with irregular longitudinal grooves; 3 simple, smooth; 4–6 with 2 simple ringlets similar in size and appearance; 7–9 with 2 annulated ringlets, first ringlet longer than second; 10–13 and clitellar segments

simple; postclitellar irregularly annulated. *Setae*: Minute, closely paired; *ab* = *cd*, *aa* < *bc* < *dd* < ½ u; on 10–16 and 21–23 *ab* setae associated with papillae. *Nephridial pores*: Conspicuous, in *cd* setal lines; first pair in intersegmental furrow 2/3. *Female pores*: On anterior part of 14 in front of *ab* setae. *Male pores*: Externally not observed, probably in area of tubercula pubertatis in intersegmental furrow 16/17, where there are small swollen glands. *Spermathecal pores*: In 2 intersegmental furrows: 12/13 13/14, with minute nodules.

Clitellar region (Fig. 3): *Clitellum*: Not fully developed, but when dorsally dissected, clitellar tissues were observed on 12–25; dorsally segmented, white; ventral edges slightly above papillae on segments 12–16 and 20–25; on segments 16–19 the edges at extension of dorsal rims of tubercula pubertatis. *Tubercula pubertatis*: Well developed, distinct; rectangular with rounded corners, smooth, segmented, rimmed. Clear rectangle on segments 16–19; on posterior part of 15 and anterior part of 20 narrow glandular extensions with thin rims. *Papillae*: Prominent tubercles associated with *ab* setae and genital glands; 7 pairs on 10–16 and 4 pairs on 21–23.

Internal characters:

Septa: Septa 4/5 5/6 slightly thickened, 6/7 thin, 7/8 8/9 thickened moderately, not muscular, firm, similar in size and appearance; 9/10 thickened likewise to 7/8, although slightly thinner. Other septa thin, firm. *Gizzard* (Fig. 4): In 7; barrel-shaped, muscular, posteriorly softened. *Calciferous glands*: In 9, muscular, encircling oesophagus, externally without dorsal or ventral separation; clearly defined anteriorly and posteriorly. *Intestine*: Commences in 13. *Typhlosole*: Commences together with intestine in 13 as narrow U-shaped tube, enlarging gradually. Terminates behind 273. *Dorsal blood vessel*: Double, close in 4–7, in 8 moderately enlarged, separated; in 9 cordiform; single, slender when crossing septa in segments 4–9; single, thick in 10 and the following segments. *Paired dorsoventral vessels*: 4–8 simple, slender tubes, 9–11 gradually enlarging, moniliform. *Oesophageal vessels*: Two vessels, well developed, were observed at both sides; their bifurcation anteriorly and posteriorly was not established. *Nephridia*: Meganephridia; 1 pair per segment; coiled loops with elongate, broadly open V-shaped, simple caeca. Caeca much longer in postclitellar segments than in clitellar segments.

Reproductive organs: *Spermiductal funnels*: Holandric arrangement. Two pairs of moderately sized funnels, iridescent, enclosed in separated sacks, each attached to posterior parts of segments 10 and 11 respectively, and with close connection to corresponding seminal sacs. *Vasa deferentia*: Commencing on lateral side of spermiductal funnels in segments 10 and 11 respectively, paired ducts are covered by thick tissue of body wall. Initially distantly paired, the ducts extend transversely before curving posteriorly and becoming closely paired, and run backward, at each side as single ducts to intersegmental furrow 16/17 where they enter body wall. *Seminal vesicles* (Fig. 4): Two pairs of broadly stalked sacs, commencing at septa 10/11 and 11/12 respectively; both pairs moderate in size, smooth-walled; anterior pair confined to segment 11, posterior pair to 12. *Spermathecae*: In 3 segments, close to septa 12/13–14/15: 12/13 = 2 + 1, 13/14 = 2 + 1, 14/15 = 1 + 1 respectively. Tubular, small, various sizes; bent or serpentine. Sperm was observed in all

spermathecae. *Ovaries*: Not observed; probably in posterior part of segment 13, covered by nephridial loops and body tissue. *Genital glands*: Paired, associated with *ab* setae and papillae. In 10–14 small, flat, glandular, composed. In 15–16 and 21–23 finger-shaped, moderate in size, single or composed of 2 or 3 glands; posterior pairs larger than anterior ones.

Biological notes: Collected from moist soil in primary grassland, in an area protected by the Vernon Crookes Nature Reserve. The neighbouring ground, situated in southern KwaZulu-Natal, has been subjected to agricultural activity, especially cultivation of sugar cane, and no microchaetids were collected from these fields.

Microchaetus ambitus was associated with two other species, namely *zaloumisi* and *vernoni*. Although the other species were collected in large numbers during fieldwork conducted several times in this area, *ambitus* was found only once and as a single specimen. This specimen, although not fully mature and with clitellum not completely developed, contains a small amount of sperm in its spermathecae, showing that it had already mated.

A number of parasitic nematodes were observed in the body cavity.

Distribution: Known only from the type locality.

Discussion: *Microchaetus ambitus* belongs to a group of species with calciferous glands encircling the oesophagus, V-shaped nephridial caeca, and multiple spermathecae in three segments. Similar to *vernoni*; both species have three pairs of spermathecae with spermathecal pores in intersegmental furrows 12/13 13/14 14/15, calciferous glands encircling oesophagus, dorsal vessel double in anterior segments and nephridial caeca V-shaped. They differ in general appearance, position of clitellum, shape of tubercula pubertatis, and thickness of septa.

Microchaetus caementerii Michaelsen, 1913

Microchaetus papillatus Benham, 1892 var. *caementerii* Michaelsen, 1913*c*: 429; Reynolds & Cook, 1976: 83.
Microchaetus caementerii: Michaelsen, 1918: 321; Pickford, 1975: 23; Plisko, 1991*a*: 282, 1995*b*: 49.
Microchaetus caementerii cf. *M. papillatus* var. *caementerii*: Reynolds & Cook, 1976: 83.

Material examined: **KwaZulu-Natal**: Pietermaritzburg, Darvill (29°36'S:30°26'E), grassland, 30 January 1991, 1 clitellate and 16 juveniles NMSA/Olig.00796; Umgeni River (29°28'S:30°29'E) on flooded bank, 6 March 1989, 3 clitellate NMSA/Olig.00839.

The external and internal characters agree with Michaelsen's (1913*c*) description and the data added by Plisko (1992 1995). This species is known only from a restricted area of Pietermaritzburg.

Microchaetus circulatus sp. n.

Fig. 5

Etymology: L. *circular* = form a circle, go around. Refers to the calciferous glands, which encircle the oesophagus.

Material examined: **Northern Cape**: *Holotype* NMSA/Olig.02535, clitellate, abscised, 19 km NE of Garies, Studer's Pass (30°24'S:18°05'E) at *ca.* 1100 m, from

water seepage at side of the road, 30 August 1989. Paratypes NMSA/Olig.00943,1 clitellate abscised and 12 juveniles, all collected together with holotype. All collected by BRS.

Description based on holotype and paratypes.

External characters:

General: Body cylindrical (all specimens slightly decomposed). *Colour:* Alcohol-preserved: yellowish-white, not showing pigmentation. *Dimensions*: Holotype abscised, somewhat stretched 80+ mm long, 3 mm wide at 10, 5 mm at tubercula pubertatis; paratypes: 1 clitellate 50+ mm, juveniles 58–110 mm. *Segment number*: Holotype 156+, juvenile paratypes 284–320. *Prostomium*: Prolobous, small. *Segmentation*: Secondary annulation present. Segments 1 and 2 fused, with irregular longitudinal grooves. Segment 3 simple; 4–8 with 2 simple ringlets similar in size and appearance; 9 with 2 ringlets, first longer than second; 10 and the following segments simple, postclitellarly sporadically annulated. *Setae*: Minute, closely paired; *ab* = *cd*, *aa* > *bc*; on 10–23 or 10–26 *ab* setae associated with small papillae. *Nephridial pores*: Conspicuous, somewhat above *cd* setal lines. *Female pores*: On 14, between *bc* setal lines. *Male pores*: Externally not detected, probably on 18. *Spermathecal pores*: Four pairs in 12/13 13/14 14/15 15/16 intersegmental furrows.

Clitellar region (Fig. 5): *Clitellum*: Saddle-shaped, segmented, white, on 13–23; clearly bordered anteriorly and posteriorly; ventral edges extend to row of papillae; on 17–20 partly overlapped by tubercula pubertatis. *Tubercula pubertatis*: Longitudinal strips at ventral clitellar edges, not clearly distinct from clitellum on 17–1/n20. *Papillae*: Minute swellings associated with *ab* setae and genital glands; on holotype on 10–23, on paratype 10–26.

Internal characters:

Septa: 4/5 5/6, 7/8 8/9 9/10 thickened moderately, slightly muscular, similar in size and appearance, firm; 6/7 thickened less than 5/6, firm. Other septa thin. *Gizzard*: In 7, cylindrical, muscular, posteriorly softened. *Calciferous glands*: In 10, encircling oesophagus and forming a single swelling, with no external separation ventrally or dorsally. *Intestine*: Commences in 13. *Typhlosole*: Commences equally to intestine in 13 as U-shaped tube. In juvenile paratype consisting of 255 segments typhlosole terminates in area of 173. *Dorsal blood vessel*: Undivided in 4–10 and following segments. Single when crossing septa. In segments 4–7 slender tube, in 8–10 moderately enlarged. *Paired dorsoventral vessels*: In segments 4–8 slender tubes, in 9–11 gradually enlarging, moniliform. *Oesophageal vessels*: Two vessels ventrolaterally, bifurcated anteriorly. Due to the poor, decomposed condition of specimens, no posterior bifurcation could be established. *Nephridia*: Meganephridia. One pair per segment of coiled loops with caeca elongated, twisted somewhat dorsally and forming J-shaped tube, which posterior end turns to nephridial porus.

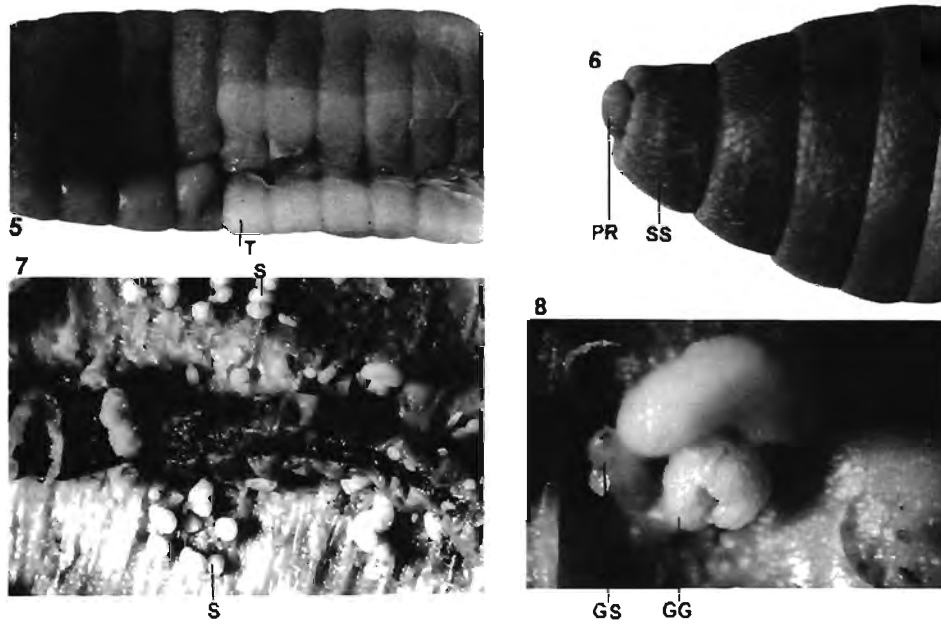
Reproductive organs: *Spermiductal funnels*: Holandric arrangement; 2 pairs of large, free funnels, attached to posterior parts of segments 10 and 11 respectively, close to seminal sacs of 10 and 11. *Vasa deferentia*: On each side paired ducts commence in segments 10 and 11 respectively, on lateral side of spermiductal funnels, extending transversely before curving posteriorly to run backward, parallel

to axis of the body. Initially separated ducts of anterior and posterior pair run at each side separately to segment 13, uniting into single duct and run backward to segment 18. Penetration of body wall is in area of posterior part of segment 18, where probably are male pores, although these were not externally observed. *Seminal vesicles*: Two pairs commencing at posterior parts of septa 10/11 and 11/12 respectively. Moderately sized pouches showing internal chambering. Each pair close to spermiductal funnels of segment 10 and 11 respectively. Anterior pair confined to segment 11, posterior pair to 12. *Spermathecae*: A pair per segment of globular, small ampullae with thin neck equal or slightly longer than ampulla. In 4 segments near septa 12/13 13/14 14/15 15/16. All spermathecae iridescent, confirming presence of sperm. *Ovaries*: Not observed; probably in posterior part of segment 13, where nephridial loops and septal tissue make observation difficult. *Genital glands*: One pair per segment of small, thin, tubular glands, in 10,11, 13–17 and 20–26. Slightly larger, moderate in size, elongated structures in 12 and 18–19. All associated with *ab* setae and papillae.

Biological notes: Collected from moist soil near water seepage at *ca.* 1200 m near summit of the Studer's Pass. The presence of juveniles collected together with fully mature specimens in which sperm is present in spermathecae, indicates sexual activity in summer, coinciding with the rainy season during July–August.

Distribution: Known only from the type locality on the Kamiesberg range.

Discussion: Similar to *rosai,* having four pairs of spermathecae with long necks, near septa 12/13–15/16, and calciferous glands encircling oesophagus. Differs in the position of clitellum and the shape of the tubercula pubertatis.



Figs 5–8. *Microchaetus* species. 5. *M. circulatus* sp. n., clitellar region, ventral view. 6–8. *M. davidi* sp. n. 6. Anterior part of body, lateral view. 7. Dorsally dissected preclitellar part of body. 8. Genital gland with genital seta. [T = tuberculum pubertatis; PR = prostomium; SS = fused segments 1 + 2; S = spermathecae of segment 16; GG = genital gland; GS = genital seta.]

Microchaetus davidi sp. n.

Figs 6–8

Etymology: Named after Dr David A. Barraclough, the Chief Curator of the Department of Arthropoda, and the editor of Natal Museum journals.

Material examined: **Northern Cape**: *Holotype* NMSA/Olig.02627, clitellate, 16 km E of Kamieskroon (30°13'S:17°55'E), near road R 355, 17 August 1997. Paratypes collected together with holotype: NMSA/Olig.02626, 1 clitellate abscised and NMSA02628, 5 juveniles. All collected by JDP & TL.

Description based on holotype and paratypes.

External characters:

General: Body cylindrical. *Colour*: In life dorsally violet-grey, ventrally grey; alcohol-preserved: anterior segments dorsally dark grey with violet tint, ventrally whitish-grey. *Dimensions*: Holotype preserved, abscised and contracted 112+ mm long, 5 mm at 10, 8 mm at tubercula pubertatis; juvenile paratypes 70–130 mm long, 4–5 mm wide; abscised clitellate 120+ mm long. *Segment number*: Holotype 230+, paratypes 205–371. *Prostomium*: Prolobous, well developed. *Segmentation*: Secondary annulation present on preclitellar segments. Segments 1 and 2 fused (Fig. 6), with irregular longitudinal grooves. Segment 3 simple, nearly as long as 1 + 2; 4–6 with 2 simple ringlets, similar in size and appearance; 7–9 with 2 irregularly annulated ringlets, second ringlet shorter than first;10 and postclitellar segments simple, irregularly annulated. Clitellar segments dorsally simple, ventrally with irregular annulation. *Setae*: Closely paired, minute; *ab* = *cd*; postclitellarly *aa* < *bc* < *dd*; *dd ca.* $\frac{1}{3}$ u; first pairs of *ab* on 4. *Nephridial pores*: Obvious on clitellar segments, anteriorly clearly noticeable; first pair in intersegmental furrow 3/4 much below *cd* setal lines. *Female pores*: On segment 14, large pores very close one to another medially. M*ale pores*: Probably in intersegmental furrow 18/19 or on segment 18 in area of tubercula pubertatis. *Spermathecal pores*: In 4 intersegmental furrows: 12/13 13/14 14/15 15/16 multiple at ventral borders of clitellum, close to nephridial pores.

Clitellar region: *Clitellum*: Saddle-shaped, as long as preclitellar part of body; on segments 12–24,25; anteriorly and posteriorly clearly bordered; ventral edges gradually diminishing in thickness below nephridial pores, slightly above *ab* setal lines. On holotype and 1 paratype external tissues were well developed, thick, segmented, yellowish-white; on other paratypes, clitellum was less marked. *Tubercula pubertatis*: Not clearly evident, flat, narrow rectangles, overlapping clitellum on 18–20,21. Dorsal edges below nephropores, ventral slightly above clitellar borders. *Papillae*: Paired tiny swellings with small depressions, associated with *ab* setae and genital glands; on 10–23.

Internal characters:

Septa: 4/5–9/10 thickened very much, muscular, firm; septum 7/8 8/9 thickened slightly less than those from anterior segments, although also thick, firm; 9/10 much thinner, although also thickened. Other septa thin, firm. *Gizzard*: In 7, cylindrical. *Calciferous glands*: Paired, dorsolateral in 10, separated widely ventrally, with narrow groove dorsally. *Intestine*: Commences in 13. *Typhlosole*: Commences

immediately with intestine as broad twice-folded tube, terminates in area of segments 215–220. *Dorsal blood vessel*: Undivided along its whole length; in 4–7 slender, in 8 and 9 enlarged. *Paired dorsoventral vessels*: 4–8 thin tubes, sometimes with moniliform structure; in 9–11 gradually enlarging, moniliform. *Oesophageal vessels*: Present, bifurcated in anterior segments, over gizzard in segment 7 and in area of calciferous glands. *Nephridia*: Meganephridia. One pair per segment of tightly coiled lateral tubules, with elongated J-shaped caeca. In posterior segments all nephridial structure much thicker than that from anterior segments.

Reproductive organs: *Spermiductal funnels*: Holandric arrangement; 2 pairs small funnels commencing at septa 10/11 and 11/12 respectively. Both pairs iridescent, with sperm. *Vasa deferentia*: Paired ducts commence in segments 10 and 11 respectively on lateral side of spermiductal funnels, extending transversely before curving posteriorly to run backwards, parallel to axis of body. Initially separated ducts of each pair extend backward at each side separately through 2 or more segments, becoming closer to one another in area of segments 13–14, and run to posterior part of segment 18, where they enter body wall. *Seminal vesicles*: Two pairs of small, composite sacs (Fig. 7), commencing in posterior parts of septa 10/11 and 11/12, confined to segments 11 and 12 respectively. In holotype anterior pair slightly smaller than posterior pair. *Spermathecae* (Fig. 7): In segments 13–16, near septa 12/13–15/16. Irregularly oval-shaped thecae with thin necks, various sizes, 1–4 at each side. In holotype 12/13 = 1 + 1, 13/14 = 2 + 2, 14/15 = 4 + 3, 15/16 = 2 + 3; in paratype 12/13 = 1 + 1, 13/14 = 1 + 2, 14/15 = 1 + 1, 15/16 = 1 + 1. *Ovaries*: Large funnels close to median line in posterior part of segment 13. *Genital glands*: Variously shaped structures associated with *ab* setae and corresponding with papillae. In 10–17 irregularly oval, bent, moderate, associated with genital setae (Fig. 8); in 18–19 larger, different in shape and size, bent or twisted sausage-shaped glands; in 20–23 small bladders similar to those of 10–17.

Biological notes: Found in moist sandy soil, between roots of various plants covering roadside ditch. In the body cavity of the holotype, a number of well-developed oocytes were observed.

Distribution: Known only from the type locality, in Namaqualand.

Discussion: Similar to my new species *hamerae*, and to *rosai*. All three species have spermathecae in four rows 12/13–15/16, undivided dorsal blood vessel, and J-shaped nephridial caeca. *M. davidi* differs in having seminal vesicles confined to segments 11 and 12, and not extended backwards as in *rosai* and *hamerae*. Spermathecae are multiple in *davidi*, paired in *hamerae* and *rosai*. The position of the clitellum and thickness of septa are also different in all three species.

Microchaetus guntheri Pickford, 1975

Fig. 9

Microchaetus guntheri Pickford, 1975: 37–42; Reynolds & Cook, 1976: 110; Plisko, 1993*b*: 235–236.

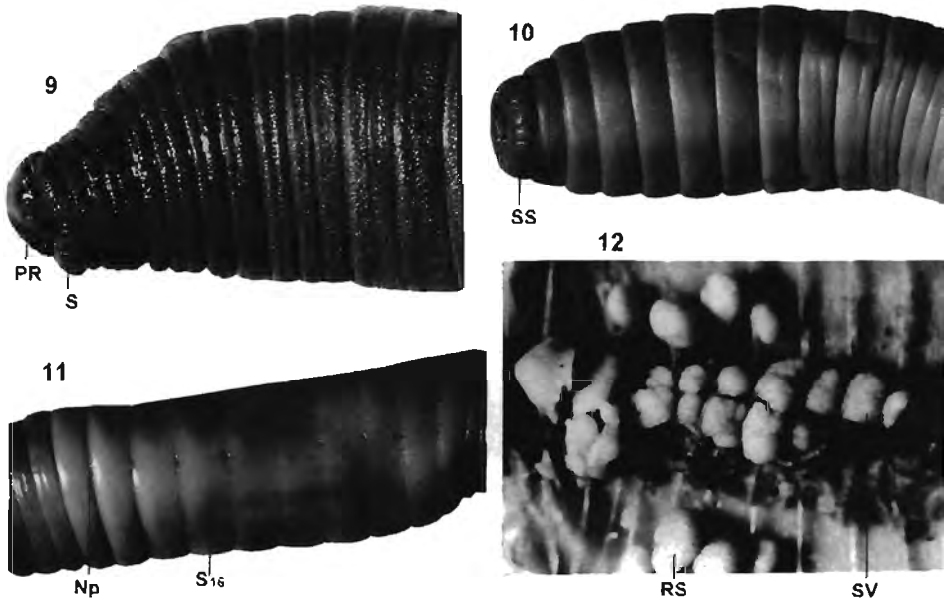
Material examined: **Western Cape**: Paratype, immature specimen in three pieces, slightly decomposed, SAM21543, from White River Valley, Bain's Kloof, marshy

area with sedge-like vegetation by stream, 12 July, 1926, E. R. Gunther & G. E. Pickford.

The external and internal characters agree with Pickford's (1975) description, except that I found the intestine commencing in segment 13, not in 14 as stated by Pickford. Prominent typhlosole commences also in segment 13, immediately with the intestine. Seminal vesicles are moderately developed and confined to segments 11 and 12 respectively, although the posterior pair is slightly larger than the anterior pair and extends into part of segment 13. It is possible that in more mature individuals the anterior pair of seminal vesicles could be more developed.

Segments 1 and 2 are separated (Fig. 9); a secondary and tertiary annulation occurring on preclitellar segments resembles a condition noted in species from the eastern parts of South Africa. In the majority of western species the first two segments are united or not well separated, and the other preclitellar segments are biannulated randomly, with only irregular tertiary annulation.

Distribution: Known only from the type locality in the Western Cape.



Figs 9–12. *Microchaetus* species. 9. *M. guntheri* Pickford, 1975, anterior part of body, lateral view with prostomium, and annulated segments. 10–12. *M. hamerae* sp. n. 10. Anterior part of body with fused segments 1 and 2, and annulated preclitellar segments. 11. Clitellum, dorsolateral view, with nephridial pores in intersegmental furrows. 12. Dorsally dissected preclitellar part of body. [PR = prostomium; S = segment 1; SS = fused segments 1 and 2; Np = nephropore; S_{16} = segment 16; RS = spermatheca of segment 14; SV = seminal vesicle extended to segment 18.]

Microchaetus hamerae sp. n.

Figs 10–12

Etymology: Named for Dr Michelle Hamer of the Natal Museum's Department of Arthropoda, who assisted me with the collection of some of the type material.

Material examined: **Western Cape**: *Holotype* NMSA/Olig.02650, clitellate, 10 km W Nieuwoutdville (31°22'S:19°06'E), near road, from sandy, moist soil, 15 September 1994, collected by JDP, BRS & M. Hamer. Paratypes (same data as holotype): NMSA/Olig.02006, 15 clitellate, 10 juveniles; NMSA/Olig.02007, 3 clitellate; NMSA/Olig.02008, 2 clitellate. Material collected by JDP & TL, 15 September 1997: Bokkeveldberge, on top of hill, near road, from muddy bank of local stream, NMSA/Olig.02651, 1 clitellate; 12 km and 7 km W of Nieuwoudtville, near road, from soaked soil, NMSA/Olig.02613; NMSA/Olig.02614, 8 clitellate, 6 juveniles; 10 km N Vanrhynsdorp (31°37'S:18°44'E), from dry bed of local stream, NMSA/Olig.02612, 5 clitellate, 5 juveniles. Other material: **Northern Cape**: 24 km S Garies (30°33'S:17°59'E), near road N 7, from moist, sandy soil, 17 August 1997: 12 clitellate NMSA/Olig.02623; 6 specimens not fully mature, NMSA/Olig.02624; 7 juveniles, NMSA/Olig.02625. **Western Cape**: 50 km N Clanwilliam (32°10'S:18°55'E), from sandy, moist soil, 18 August 1997: 1 clitellate complete, NMSA/Olig.02632; 2 abscised, NMSA/Olig.02633; 1 clitellate, 2 postclitellar ends, NMSA/Olig.02634.

Description based on holotype and paratypes.

External characters:

General: Body cylindrical. *Colour*: In life dorsally dark grey with violet tint, ventrally grey. Alcohol-preserved: violet on preclitellar segments, ventrally whitish-grey. *Dimensions*: Holotype in life *ca.* 130 mm long; preserved and contracted 115 mm long, 4 mm at 10, 5 mm at tubercula pubertatis; paratypes preserved 80–190 mm long, 4–6 mm wide at 10, 5–7 mm at tubercula pubertatis. *Segment number*: Holotype 312, paratypes 310–469. *Prostomium*: Prolobous, small. *Segmentation*: Secondary annulation present on preclitellar segments. Segments 1 and 2 fused (Fig. 10), with irregular longitudinal grooves. Segment 3 simple, as long as 1 + 2; 4–7 with 2 simple ringlets similar in size and appearance; 8–9 with 2 irregularly annulated ringlets, second shorter than first; 10 and postclitellar segments simple. Clitellar segments much longer than posterior, simple. *Setae*: Closely paired, minute; *ab* = *cd*; postclitellarly *aa* < *bc* < *dd*; *dd* = *ca.* $\frac{1}{3}$ u; first pairs of *ab* on 3. *Nephridial pores*: Obvious, more clearly noticeable on clitellar segments (Fig. 11); first pair in intersegmental furrow 3/4, much below *cd* setal lines. *Female pores*: On segment 14 between *bc* setae. *Male pores*: On 18 in area of tubercula pubertatis, with small invaginations. *Spermathecal pores*: In 4 intersegmental furrows 12/13 13/14 14/15 15/16 close to nephridial pores; 1 pair per segment.

Clitellar region: *Clitellum* (Fig. 11): Saddle-shaped with long, clearly demarcated segments; in alcohol-preserved material anteriorly yellowish-white; clearly bordered anteriorly and posteriorly, on 12,13–22,1/n23,23,24; ventral edges below nephropores, nearly touching *ab* setal lines. *Tubercula pubertatis*: Oval, not glandular, flat, overlapping clitellum on 1/n16,17–20. Dorsal edges much below nephropores, ventral borders slightly above *b* setal lines at ventral edges of clitellum. *Papillae*: Paired swellings associated with *ab* seta, on 10–23,24, moderate in size. Posteriorly gradually diminishing in size. On some paratypes papillae of segment 16 were slightly out of usual lines, closer to tubercula pubertatis.

Internal characters:

Septa: 4/5 5/6 thickened moderately, not muscular but firm, similar in size and appearance; 7/8 8/9 thickened slightly less than those of anterior segments, although similar to them; 6/7 9/10 also thickened, but less than 7/8. Other septa thin, firm. Variation in thickness of septa observed in individuals from different populations and also in specimens from the same population. *Gizzard*: In 7, cylindrical. *Calciferous glands*: Paired, dorsolateral in 10, bulging, push septum 10/11 to occupy nearly whole space of segment 11. Clearly separated ventrally and dorsally. *Intestine*: Commences in 13. *Typhlosole*: Commences immediately with intestine as twice-folded thin tube, gradually enlarging into U-shape. Terminates in area of segments 174–186. In one specimen from Clanwilliam manifesting abnormality in segment regeneration, a typhlosole was extended to segment 297. *Dorsal blood vessel*: Undivided, simple over its whole length. In 4–7 slender vessel, in 8–10 enlarged. *Paired dorsoventral vessels*: In 4–8 thin, simple tubes, in 9–11 gradually enlarging, moniliform. *Oesophageal vessels*: Present, commencing and bifurcate in anterior segments, extending to area of calciferous glands. *Nephridia*: Meganephridia. One pair per segment of tightly coiled tubules with elongate caeca, ectal end becomes J-shaped. In postclitellar segments nephridia much thicker than those of anterior segments.

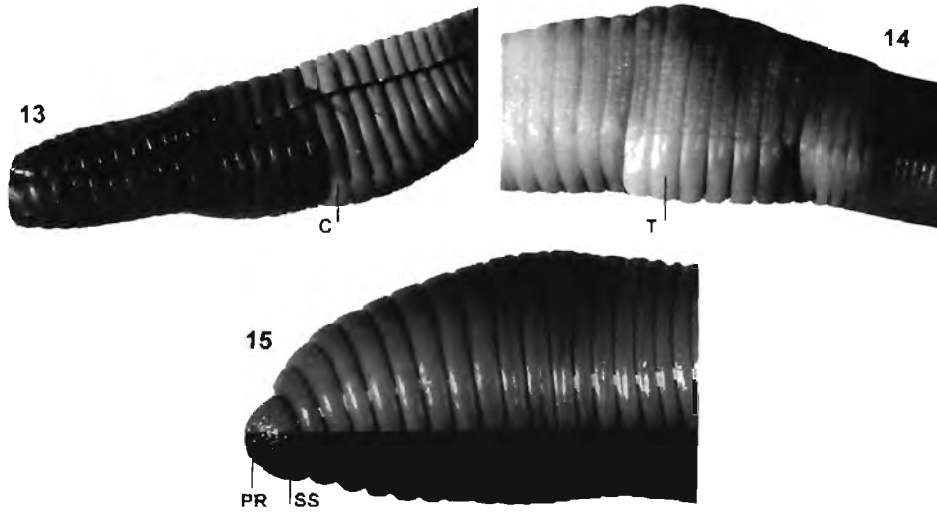
Reproductive organs: *Spermiductal funnels*: Holandric arrangement. In most dissected specimens both funnels large, similar in size and appearance, with iridescence confirming presence of sperm; commence in segments 10 and 11 respectively. *Vasa deferentia*: Commence in 10 and 11 respectively on lateral side of spermiductal funnels, and extend transversely before curving posteriorly to run backward, parallel to axis of the body. Initially separated, paired ducts run through 2 or more segments separately, becoming very close together in area of segments 11–13, and run to segment 18, where they unite before entering body wall at posterior part of segment 18. In some dissected specimens, however, both ducts run separately to segment 17, where they unite before entering body wall in 18. *Seminal vesicles* (Fig. 12): Two pairs of highly lobulated, pouched sacs, different in size and appearance, commence at septa 10/11 and 11/12 respectively. Anterior pair much smaller than posterior pair and confined usually to segment 10. Posterior pair form bulging pouches extending from segments 11 to 17–23,24, often differently on left and right side. In holotype the sacs of second pair extend on left side to segment 17, on right side to segment 19. In dissected paratypes the length, number of bulged pouches, and their extension into posterior segments, are variable, some reach as far as segment 24. Irregularity was also observed in the position of one or both vesicular pouches, which being extended backward, can be twisted forwards from segments 23 to 17. *Spermathecae* (Fig. 12): Four pairs of large, ovoid ampullae, with long, slender ducts, which enter body wall in 4 rows, near septa 12/13–15/16. Although shape and size vary relative to presence of sperm, usually anterior and posterior pairs are much smaller than those of segments 14 and 15. If sperm absent, ampulla is translucent, and much smaller. *Ovaries*: Not observed. *Genital glands*: Variable in size, oval, associated with *ab* setae, corresponding with papillae, in 10–23,24.

Biological notes: Found in moist soil near roads, and hillsides covered by indigenous

bush. Collected also from sandy soil of a dry riverbed, and sandy soil along roads. Occurs between roots of various plants at variable depths. The presence of sperm observed in the holotype and a majority of dissected paratypes confirms sexual activity in spring and summer, coinciding in western South Africa with the rainy season.

Distribution: Widely distributed in Namaqualand escarpment mountains.

Discussion: Belongs to the group of species with seminal vesicles extended over more than two segments. Most similar to *M. rosai* Michaelsen, 1908, having paired spermathecae in four intersegmental furrows 12/13–15/16, and last pair of seminal vesicles extended backwards to posterior segments. The non-alignment of a few pairs of *cd* setae, as reported by Michaelsen (1908) for *rosai*, was observed on some individuals of *hamerae*. These species differ in the shape of calciferous glands, position of the clitellum, and number of thickened septa.



Figs 13–15. *Microchaetus* species. 13–14. *M. imitatus* sp. n. 13. Anterior part of body, dorsolateral view with annulated segments and clitellum. 14. Ventrolateral view with tuberculum pubertatis. 15. *M. ljungströmi* Pickford, 1975, anterior part of body, dorsolateral view with fused segments 1 and 2, and annulated preclitellar segments. [C = clitellum; T = tuberculum pubertatis; PR = prostomium; SS = fused segments 1 and 2.]

Microchaetus imitatus sp.n.

Figs 13–14

Etymology: L. *imitatus* = similar to. Refers to resemblance to *M. pauli*.

Material examined: **Western Cape**: *Holotype* NMSA/Olig.02670, clitellate, 17 km NW Porterville (33°00'S:19°00'E), from ditch near road 44, 13 August 1997. Paratypes collected with holotype: 2 clitellate, 4 juveniles, NMSA/Olig.02673. All material collected by JDP & TL.

Description based on holotype and paratypes.

External characters:

General: Body cylindrical. *Colour*: In life dorsally violet-dark grey, ventrally light grey; alcohol-preserved: dorsally dark grey, some specimens with violet tint on preclitellar segments; ventrally whitish-grey. *Dimensions*: Holotype preserved and contracted 92 mm long, 5 mm at 10, 7 mm at tubercula pubertatis; paratypes preserved 76–88 mm long, 4–5 mm wide at 10, 5–7 mm at tubercula pubertatis. *Segment number*: Holotype 265, paratypes 221–300. *Prostomium*: Prolobous, small. *Segmentation*: Secondary annulation present on preclitellar segments. Segments 1 and 2 fused, with irregular longitudinal grooves. 3 simple, as long as 1 + 2; 4–7 with 2 simple ringlets similar in size and appearance; 8–9 with 2 ringlets, second shorter than first; 10 and postclitellar segments simple; clitellar segments simple. *Setae*: Closely paired, minute; *ab* = *cd*; postclitellarly *aa* < *bc* < *dd* < $\frac{1}{2}$u; first pairs of *ab* on 3. *Nephridial pores*: Not observed. *Female pores*: Probably below papillae on segment 14, where there are tiny depressions. *Male pores*: Probably in intersegmental furrow 18/19, where vasa deferentia enter body wall. *Spermathecal pores*: In 6 intersegmental furrows: 11/12 12/13 13/14 14/15 15/16 16/17, near nephridial pores; multiple.

Clitellar region (Fig. 13): *Clitellum*: Saddle-shaped, anteriorly not clearly demarcated, posterior segments whitish-grey. On 12–16 only dorsal portions of segments covered with clitellar tissue; on 17–26 clitellar tissue well developed, with ventral edges at dorsal borders of tubercula pubertatis; clearly separated from tubercula pubertatis by zig-zag rims. *Tubercula pubertatis* (Fig. 14): Oblong, broad bands, segmented; on 17–23,24; dorsally below clitellar edges, separated from clitellum by clear rims; ventral borders just above *ab* setae. *Papillae*: Paired small swellings, associated with *ab* seta, on 10–17 and 24–26.

Internal characters:

Septa: 4/5 5/6, 7/8 8/9 thickened, similar in size and appearance; 6/7, 9/10 and other septa thin. *Gizzard*: In 7, barrel-shaped. *Calciferous glands*: Dorsolateral, in 10; separated dorsally and ventrally. *Intestine*: Commences in 13. *Typhlosole*: Commences immediately with intestine as narrow tube, gradually extending and changing into broad, sometimes folded, structure; in holotype terminates in 161. *Dorsal blood vessel*: Undivided, simple, over entire length; in 4–7 thin tube, in 8 enlarged, in 9 large, thick organ. *Oesophageal vessels*: Present, commence in anterior segments, extending to area of calciferous glands in segment 10. *Paired dorsoventral vessels*: 4–8 thin tubes, sometimes with moniliform structure; 9–11 gradually enlarging, moniliform hearts. *Nephridia*: Meganephridia; 1 pair per segment. In postclitellar segments tightly coiled, elongated tubules, with J-shaped tubule.

Reproductive organs: *Spermiductal funnels*: Holandric arrangement; 2 pairs, well developed, iridescent, commencing at septa 10/11 and 11/12. In segments 10 and 11 small clusters of floating sperm observed. *Vasa deferentia*: On each side paired ducts commence in segments 10 and 11 on lateral side of spermiductal funnels, and extend transversely before curving posteriorly to run backward, parallel to axis of the body. Initially separated, ducts run backward separately to posterior part of segment 18, there uniting and entering body wall at intersegment 18/19. *Seminal vesicles*: One

pair of sacs commencing posteriorly to septum 10/11, extending through segments 12–15, sometimes twisting forwards. Portions of sacs in segment 11 are narrow and transparent. After passing through septum 11/12, both vesicles become bulging. *Spermathecae*: In segments 12–16, near septa 11/12–16/17. Small globular ampullae, with very thin necks, often deeply embedded in body tissue. Numbers of ampullae vary in the rows from 1–8 at each side. Ampullae varied in number amongst specimens examined. *Ovaries*: Not observed. *Genital glands*: Oval, small to moderate bladders, associated with *ab* seta, and corresponding with papillae; in segments 9–30.

Biological notes: Found in moist, sandy soil in a ditch surrounded by fynbos. Occurs between roots of various plants. Presence of sperm observed in spermiductal funnels and spermathecae, confirms bisexual reproduction.

Distribution: Known only from the type locality in the Western Cape.

Discussion: Similar to my new species *senarius* and *pauli*. All these species are characterised by multiple, small spermathecae in six rows, with spermathecal pores in intersegmental furrows 11/12–16/17. *M. senarius* has two pairs of seminal vesicles. In *imitatus* the anterior pair of seminal vesicles is reduced, in *pauli* the posterior pair is reduced. The species differ in the position of the clitellum and shape of the tubercula pubertatis.

Microchaetus ljungströmi Pickford, 1975

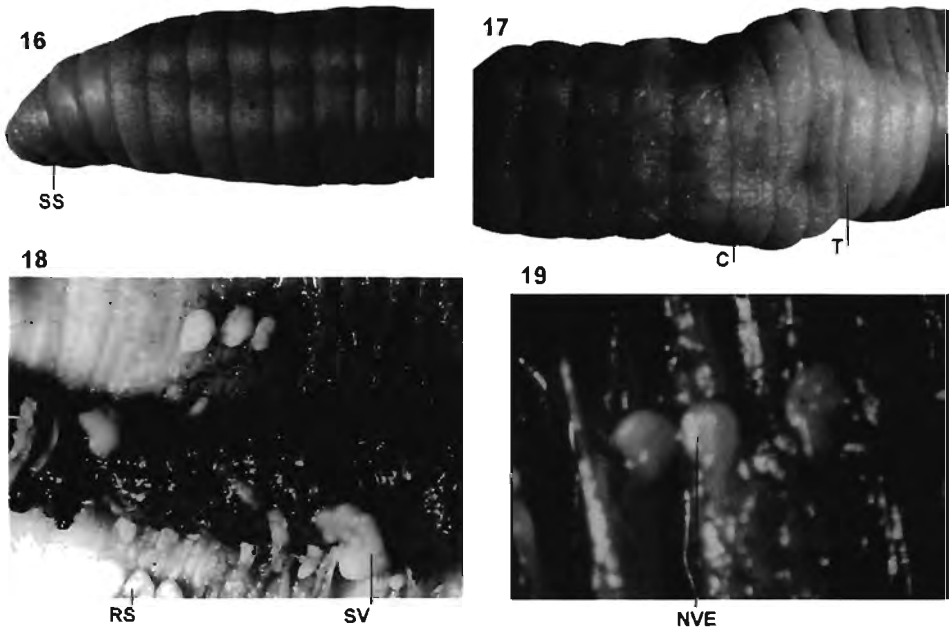
Fig. 15

Microchaetus ljungströmi Pickford, 1975: 50—57; Reynolds & Cook, 1976: 129; Plisko, 1993*b*: 235–236.

Material examined: **Western Cape**: *Holotype* (incompletely mature), SAM21541, Tulbagh District, Great Winterhoek, at *ca.* 4000–5000 ft, 16 April 1916, K. H. Barnard.

External and internal characters agree with Pickford's (1975) description, with some exceptions. Prostomium (Fig. 15) is clearly prolobous (not zygolobous). Septa 4/5 5/6 6/7 are thickened moderately, 7/8 8/9 thickened more than anterior septa, muscular; 9/10 thickened less than 8/9. *Gizzard*: Cylindrical. Typhlosole commences in same segment as intestine; Pickford stated that intestine commences in 12. Due to poor condition of holotype, exact position of intestine and typhlosole cannot be confirmed.

Pickford having limited microchaetid material, considered the characters of thickened septum 9/10 and a backward extension of seminal vesicles to segment 22 or 23 to be unique to this species. The present study shows that septum 9/10 is thickened in other species (*circulatus, hamerae, occidualis, davidi*). The backward extension of posterior seminal vesicles occurs also in ten holandric species: *alipentus, hamerae, obscurus, occidualis, occiduus, pentus, pearsonianus, imitatus, rosai* and *senarius,* and in the metandric species *metandrus*. It is noteworthy that such extension of seminal vesicles is a peculiarity only of some species occurring in western South Africa.



Figs 16–19. *Microchaetus metandrus* sp. n. 16. Anterior part of body, dorsolateral view with fused segments 1 and 2, and annulated preclitellar segments. 17. Clitellar region, ventral view with clitellum and tuberculum pubertatis. 18. Dorsally dissected preclitellar part of body. 19. Ventral end of nephridial caeca (very much enlarged). [SS = fused segments 1 and 2; C = clitellum; T= tuberculum pubertatis; RS = spermatheca of segment 14; SV = seminal vesicle extended to segment 24; NVE = nephridial ventral end.]

Microchaetus metandrus sp. n.

Figs 16–19

Etymology: G. *meta* = involving change, *andros* = male. Refers to position of the testes. The word *metandry*, as used in oligochaetology, means that testes are restricted to segment eleven, as is the case in this species.

Material examined: **Western Cape**: *Holotype* NMSA/Olig.02669, clitellate, 19 km N of Ceres (33°21'S:19°19'E), near road R 46 on hillside with proteas and rocky, sandy soil, 13 August 1997. Paratypes: NMSA/Olig.02652, 1 clitellate, 8 juveniles, collected together with holotype; NMSA/Olig.02655, 18 km SE Porterville (33°00'S:19°00'E), from ditch near road 44, 18 August 1997, 1 clitellate. All material collected by JDP & TL.

Description based on holotype and paratypes.

External characters:

General: Body cylindrical. *Colour*: In life dorsally violet-grey, ventrally grey; alcohol-preserved: dorsally dark grey, ventrally whitish-grey. *Dimensions*: Holotype preserved 86 mm long, 4 mm at 10, 7 mm at tubercula pubertatis. Paratypes preserved 60+ to 92 mm long, 5 mm wide at 10, 6 mm at tubercula pubertatis. *Segment number*: Holotype 224, paratypes 131+ to 236. *Prostomium*: Prolobous,

small. *Segmentation*: Secondary annulation present on preclitellar segments. Segments 1 and 2 fused (Fig. 16), with irregular longitudinal grooves; 3 simple, as long as 1 + 2; 4–7 with 2 simple ringlets similar in size and appearance; 8–9 with 2 ringlets, second shorter than first. *Setae*: Closely paired, minute; first pair of *ab* on 3; *ab* = *cd*; postclitellarly *aa* < *bc* < dd < $\frac{1}{2}$ u. On segments 10–24 rows of *ab* setae are diverging and converging, with wider distances on segments 10–13, approaching distance on 14–16, and again diverging on segments 17–20. *Nephridial pores*: First pair in intersegmental furrow 3/4 between *b–c* setae. *Female pores*: On segment 14 above ventral edges of clitellum. *Male pores*: In intersegmental furrow 18/19 below ventral edges of tubercula pubertatis. In all dissected specimens a single vas defferens commences at each side of segment 11 and runs backward to posterior part of segment 18, where it enters body wall. *Spermathecal pores*: In 3 intersegmental furrows 13/14 14/15 15/16, minute.

Clitellar region (Fig. 17): *Clitellum*: Clearly bordered anteriorly and posteriorly, on segment 13–22. Ventrally extended to lines of *b* setae. *Tubercula pubertatis*: Oblong, not glandular bands, segmented, overlapping clitellum on 17–20. Dorsal edges much below nephropores, ventral edges close to *ab* setae. *Papillae*: Paired, minute swellings associated with *ab* seta on 10–24.

Internal characters:

Septa: 4/5 5/6 6/7 little thickened, not muscular, elastic; 7/8 8/9 9/10 much thickened, muscular, firm; other septa thin. *Gizzard*: In 7, cylindrical. *Calciferous glands*: Paired, dorsolateral, separated ventrally and dorsally, in segment 10. *Intestine*: Commences in 12. *Typhlosole*: Commences immediately with intestine as thin V-shaped structure, gradually enlarging into U-shape. Terminates in holotype in segment 140. *Dorsal blood vessel*: Undivided over entire length; in segments 4–7 slender, in 8–10 and following segments enlarged. *Paired dorsoventral vessels*: In segments 4–6 thin tubes, in 7 slightly thicker, sometimes moniliform, in 9–11 much enlarged, moniliform. *Oesophageal vessels*: Present. Bifurcating in anterior segments, in area of gizzard and calciferous glands. *Nephridia*: Meganephridia. One pair per segment; in postclitellar segments each nephridial body consists of long, coiled loops, and elongate, widely open V-shaped caeca, with ventral end bent, crooked and rounded (Fig. 18).

Reproductive organs: *Spermiductal funnels*: Metandric arrangement. In two mature dissected specimens, one pair of well-developed, iridescent funnels was observed in segment 11. *Vasa deferentia*: A pair of single ducts commences in segment 11 at each side of body, lateral to spermiductal funnels. Both ducts extend transversely before curving posteriorly to run backward, parallel to axis of body, to posterior part of segment 18, where they enter body wall at intersegment 18/19. *Seminal vesicles*: One pair of highly lobulated pouches, commencing at septum 11/12, bulging backwards and forwards, extending to segments 21, 24 (Fig. 19) or in some individuals to 40. Some irregularities in shape and position of vesicles observed. In holotype a vesicle of right side anteriorly was overlapping intestine dorsally, while posteriorly was twisting to ventral side of body. In paratypes both vesicles extended ventrally under intestine. *Spermathecae*: In segments 13 14 15 with short necks near to septa 13/14–15/16. One pair of ovoid or reniform flattened thecae per segment; variable in

size from small to moderate. *Ovaries*: Not observed. *Genital glands*: Size variable, small to moderate, oval, elongated structures associated with *ab* seta and corresponding with papillae, in 10–24.

Biological notes: Found in moist soil, between roots of various plants covering hillside and in ditch near the road. Presence of sperm in spermiductal funnels and in spermathecae confirms sexual maturity. The number of juveniles collected together with clitellate individuals indicates reproductive activity at the beginning of summer, which coincides in this region with the rainy season.

Distribution: Known from the type locality and its neighbourhood, in the Western Cape.

Discussion: A species well characterised by metandry, and possession of only the posterior pair of spermiductal funnels, one pair of vasa deferentia, and the posterior pair of seminal vesicles. The metandric condition is unique to this species and may suggest that *metandrus* is not closely related to any other species of *Microchaetus*, all of which are holandric. In fact, other features show it to be one of a distinctive group of species occurring in the western part of South Africa (Table 3). Characters of this group are as follows: reduction of anterior pair of seminal vesicles, and backward extension of the remaining pair, retention of both pairs of spermiductal funnels, and presence of both pairs of vasa deferentia. This combination of character states was found in 10 holandric species; in another two holandric species, a reduction of the posterior seminal vesicles with associated backward extension of the anterior pair, has been observed (Table 2 and 3). Pickford (1975) reported for some individuals of *M. pearsonianus* a reduction of testes in segment 10, associated with loss of the anterior seminal vesicles and retention of two pairs of vasa deferentia united in segment 12. Incomplete or incipient metandry thus occurs among several western species, and is an apomorphic trend.

Microchaetus mkuzi Plisko, 1992

Microchaetus mkuzi Plisko, 1992: 341; 1993*b*: 236.

Material examined: **KwaZulu-Natal**: Itala Game Reserve, near Simongweni (27°35'S:31°13'E), from marshy grassland, 26 November 1993, 5 clitellate, 10 juveniles, NMSA/Olig.01759; from marshy riverine bush, 30 November 1993, 3 juveniles, NMSA/Olig.01819.

The species is known only from two localities: muddy riverine bush on bank of Mkuzi river in the Mkuzi Game Reserve (Plisko 1992) and from the locality recorded above.

Microchaetus natalensis (Kinberg, 1867)

Geogenia natalensis Kinberg, 1867: 100; Perrier, 1886: 876; Beddard, 1895: 636; Michaelsen, 1899*b*: 428; Reynolds & Cook, 1976: 143.

Geogenia (*Microchaeta*?) *natalensis*; Michaelsen, 1899*b*: 428.

Geogenia (*Microchaetus*?) *natalensis*; Michaelsen, 1900: 462.

Microchaetus natalensis; Michaelsen, 1913*c*: 422; 1918: 324; Brinkhurst & Jamieson, 1971: 739; Pickford, 1975: 23; Reynolds & Cook, 1976: 143; Plisko, 1991*a*: 287; 1992: 345; 1993: 235; 1995*a*: 281; Reynolds, 1993: 6.

Material examined: **KwaZulu-Natal**: Magut Hills [27°32'S:31°39'E], under boulders, from rich soil, October 1929, 3 clitellate, W. H. Bell-Marley. Vryheid (27°46'S:30°47'E), near road to Melmoth, from grassland soil, 16 December 1995, 2 clitellate, 1 juvenile, JDP & TL, NMSA/Olig.02298. Umfolozi Game Reserve near Mpila Camp (28°18'S:31°51'E), from garden, dry soil, 28 May 1995, 3 clitellate, 2 juveniles, JDP, NMSA/Olig.02102. Pietermaritzburg (29°35'S:30°25'E): collected by JDP: Montrose, from garden soil, 5 February 1991, 1 juvenile, NMSA/Olig.01041; Scottsville, on bank of ditch near Umsindusi river, 4 January 1989, 1 clitellate, 1 juvenile, NMSA/Olig.00814; Hayfields, grassland, 1 October 1995, 1 clitellate, NMSA/Olig.02165; Golf Course, collected with formol solution, 7 March 1994,1 clitellate, 2 juveniles, NMSA/Olig.01307; Darvill, grassland, 30 January 1991,1 juvenile, NMSA/Olig.00799. Payn Street, February 1913, 2 clitellate, 1 juvenile, W. G. Rump, NMSA/Olig.00302; Town, grassland, 20 March 1976, 11 specimens, J. A. van Huysten, NMSA/Olig.01347; Scottsville, from garden soil, 14 March 1996,1 clitellate, T. Liversage, NMSA/Olig.02307. Ngele Forest (30°35'S:29°41'E) from moist soil on bank of a ditch, 23 November 1995,1 juvenile, JDP & BRS NMSA/Olig.02184; 5 km N Mooiriver (29°12'S:30°01'E), from moist soil in primary grassland near road M3, 5 December 1996, 1 clitellate, 10 juveniles, JDP & TL, NMSA/Olig.02446.

External and internal characters of this species accord with Michaelsen's (1899*b* 1913*c*) accounts and Plisko's (1991*a* 1992 1995*a*) redescriptions. Only the following data need to be added: oesophageal vessel present, bifurcated in anterior segments, in area of gizzard and calciferous glands. Intestine commences in 13. Typhlosole commences in area of segment 20 in form of thick U-shaped tube.

Biological notes: Recorded from natural and from moderately changed or disturbed biotopes (sports fields, ornamental gardens and lawns). Often associated with other microchaetids or with introduced exotic species. In Ngele Forest it was associated with *Tritogenia ngelensis* Plisko, 1997, and *Octolasion lacteum* (Oerley, 1885). In the sample from Mooi River were also specimens of *Proandricus jasoni* Plisko, 1992, and juvenile *Tritogenia*.

Discussion: Although Kinberg (1867) described only the external characters, redescriptions based on the type material (Michaelsen 1899*b*) and other available collections (Michaelsen 1913*c* 1918; Plisko 1991*a* 1992) have detailed also the internal characters. The calciferous glands were clearly described by Michaelsen (1913*c*) thus: 'a pair of nearly globular calciferous glands spring laterally from the oesophagus'. However, Brinkhurst & Jamieson (1971), following a statement from the Ljungström's unpublished manuscript, have stated that the calciferous glands in this species are ring- or horseshoe-shaped, and suggested on this basis the reinstatement of the genus *Geogenia*, in which *natalensis* was originally described. This suggestion led to comments by Pickford (1975), who found a paired condition of calciferous glands in *natalensis*; she opposed the resurrection of *Geogenia*. In all studied material of this species (Plisko 1991*a* 1992 1995*a*) the calciferous glands were found constantly as hemispherical paired structures, attached to the oesophagus at narrow orifices. Part of the microchaetid material seen by Ljungström, which is now housed in the Natal Museum, contains no specimens of *natalensis*.

M. natalensis is widely distributed in eastern southern Africa, occurring in the southern part of KwaZulu-Natal, Zululand, Mpumalanga, Swaziland, and eastern Northern Province. Possibly it also occurs in Mozambique and south-eastern Zimbabwe (Plisko 1995*a*). It is recorded from many localities in natural environments: grasslands, indigenous bush, forest, riparian areas, or in other biotopes not disturbed by agricultural activities. Occasionally found also in soils of lawns, vegetable and ornamental gardens, or waste disposal sites, within areas of its natural occurrence.

Microchaetus obscurus sp. n.

Fig. 20

Etymology: L. *obscurus* = indistinct. Refers to the weakly delineated clitellum of this species.

Material examined: **Western Cape**: *Holotype* NMSA/Olig.02595, clitellate, 18 km SE Porterville (3300'S:1900'E), from ditch near road R 44, 13 August 1997. Paratypes: NMSA/Olig.02654, 6 clitellate, 7 juveniles, collected together with holotype. All material collected by JDP & TL.

Description based on holotype and paratypes.

External characters:

General: Body cylindrical. *Colour*: In life dorsally violet-dark grey, ventrally grey; alcohol-preserved: dorsally dark violet, ventrally whitish-grey. *Dimensions*: Holotype preserved and contracted 90 mm long, 5 mm wide at 10, 7 mm at tubercula pubertatis; paratypes preserved 90–105 mm long, 6 mm wide at 10, 10 mm at tubercula pubertatis. *Segment number*: Holotype 221, paratypes 182–260. *Prostomium*: Prolobous, small. *Segmentation*: Secondary annulation present. Segments 1 and 2 fused, with irregular longitudinal grooves. Segment 3 simple, as long as 1 + 2; 4–8 with 2 simple ringlets similar in size and appearance; 9 with 2 ringlets, second shorter than first. *Setae*: Closely paired, minute. First pair of *ab* on 3. Postclitellarly $ab = cd$; $aa < bc < dd < \frac{1}{2}$ u. *Nephridial pores*: Clearly visible on clitellar segments; first pair in intersegmental furrow 3/4 much below *cd* setae. *Female pores*: Probably on segment 14 in front of *ab* setae, where there are minute invaginations. *Male pores*: Externally not observed; probably in intersegmental furrow 18/19 at edges of dorsal borders of tubercula pubertatis. United vasa deferentia enter body wall in posterior part of segment 18. *Spermathecal pores*: In 5 intersegmental furrows 12/13 13/14 14/15 15/16 16/17, minute.

Clitellar region (Fig. 20): *Clitellum*: Indistinct, not fully developed, with no clear borders anteriorly, posteriorly and ventrally. Dorsally dissected individuals display slightly thicker, clitellar tissue in area of segments 12,13–27,28, suggesting presence of developing clitellum. *Tubercula pubertatis*: Oblong rectangles, segmented, overlapping clitellum on 1/n17,17–1/n24, 24. Ventrally extending below nephropores and *ab* setae. *Papillae*: Paired minute swellings, associated with *ab* seta on all or only on some of segments 10–29,30.

Internal characters:

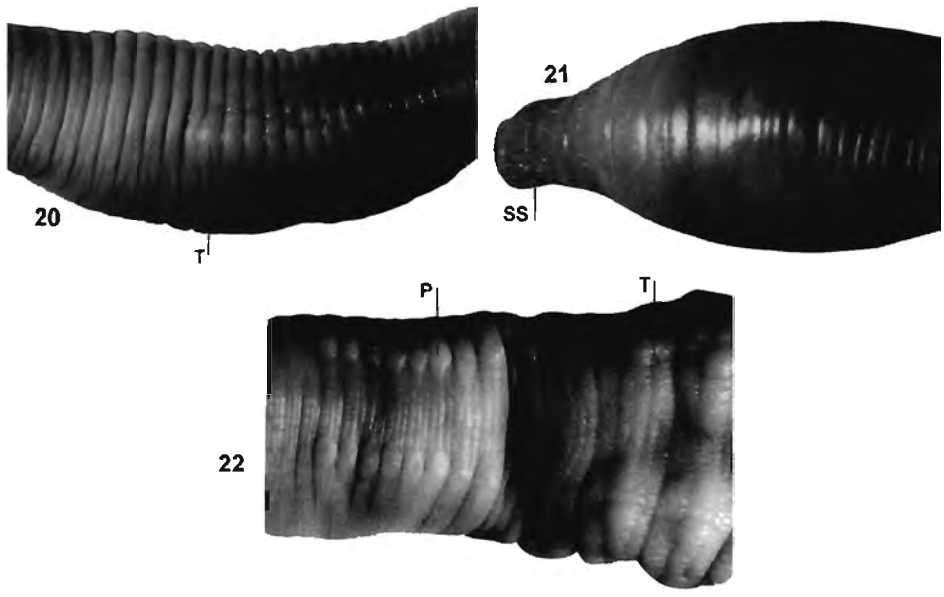
Septa: 4/5 5/6, 7/8 8/9 thickened moderately, not muscular, elastic, similar in size and appearance; 6/7 and 9/10 thickened a little bit, firm. Other septa thin, firm. Large variations in thickness of septa observed. *Gizzard*: In 7, cylindrical. *Calciferous glands*: Paired, dorsolateral, in 10, separated ventrally and dorsally. *Intestine*: Commences in 13. *Typhlosole*: Commences immediately with intestine as 2- or 3-folded, flat structure, gradually extending into slender U-shape. Terminates in holotype in segment 177. *Dorsal blood vessel*: Undivided, simple. In segments 4–7 a thin tube, in 8–9 slightly thicker, enlarged in 10 and following segments. *Paired dorsoventral vessels*: In segments 4–8 thin tubes, sometimes with moniliform structure; in 9–11 gradually enlarging, moniliform. *Oesophageal vessels*: Present. *Nephridia*: Meganephridia. One pair per segment of tightly coiled, elongate tubules, with elongated J-shaped caeca, which enter nephridial pore at apex of curved end.

Reproductive organs: *Spermiductal funnels*: Holandric arrangement. Two pairs of iridescent, well-developed funnels observed in dissected specimens, confirming maturity. *Vasa deferentia*: Paired ducts commence at each side in segments 10 and 11 respectively, lateral to spermiductal funnels, and extend transversely before curving posteriorly to run backward, parallel to axis of the body. Initially widely separated ducts unite in posterior part of segment 18, where enter body wall at intersegment 18/19. *Seminal vesicles*: Two pairs of sacs, commencing posteriorly in segments 10 and 11 respectively. Anterior pair confined to segment 11, posterior pair to 12, extending sometimes to 13. *Spermathecae*: In segments 12–16, near to septa 12/13–16/17. Multiple tiny globular bladders, of various sizes, 1–8 at each side. *Ovaries*: Not observed. *Genital glands*: Variously sized, oval structures associated with *ab* seta and corresponding with papillae, in 10–29, 30.

Biological notes: Found in moist soil, between roots of various plants covering a ditch near the road. The sample included juvenile and mature specimens. Dissected individuals with an incompletely developed clitellum contain sperm in spermiductal funnels and spermathecae, confirming maturity and sexual activity. Such a clitellar condition can indicate late development in spring or quiescence during winter. It is difficult, however, to determine the reason for the thin clitellar layer. The colouring of clitellar tissue observed in this species does not indicate any absorption of clitellar tissue; usually this occurs in other microchaetids during quiescence or diapause, in which case the clitellar area during aestivation changes to brown. It is possible that mating in this species occurs between individuals with partly developed clitella.

Distribution: Known only from the type locality in the Western Cape.

Discussion: Similar to *pentus* in general appearance, number of rows of spermathecal pores, multiple spermathecae, shape of calciferous glands, and shape of nephridia. Both species are characterised by extension of the posterior pair of seminal vesicles. They differ in the shape and position of the clitellum and tubercula pubertatis.



Figs 20–22. *Microchaetus* species. 20. *M. obscurus* sp. n., clitellar region, ventrolateral view with tuberculum pubertatis. 21–22. *M. occidualis* sp. n. 21. Anterior part of body with fused segments 1 and 2. 22. Ventral view, with tubercula pubertatis, and rows of papillae. [T = tuberculum pubertatis; SS = fused segments 1 and 2; P = papilla.]

Microchaetus occidualis sp. n.

Figs 21–22

Etymology: L. *occidualis* = western. This species was found in the western part of South Africa.

Material examined: **Western Cape**: *Holotype* NMSA/Olig.02608, clitellate, 21 km S of Clanwilliam (33°10'S:18°55'E), swamp near road N7, 14 August 1997. Paratypes collected together with holotype: NMSA/Olig.02607, 1 clitellate in 2 pieces; NMSA/Olig.02609, 31 juveniles; NMSA/Olig.02656, 1 clitellate abscised. All material collected by JDP & TL.

Description based on holotype and paratypes.

External characters:

General: Body cylindrical. Segments 1–3 snout-like, much narrower than following segments (Fig. 21). *Colour*: In life dark grey; alcohol-preserved: whitish-grey. *Dimensions*: Holotype in life (slightly stretched) 200 mm long. Preserved and contracted 190 mm long, 6 mm wide at 10, 10 mm at tubercula pubertatis. Clitellate paratype 150 mm long, 6 mm wide at 10, 11 mm at tubercula pubertatis. Juvenile paratypes 60–140 mm long, 4–7 mm wide. *Segment number*: Holotype 296, clitellate paratypes 204+ to 241; juveniles 276–309. *Prostomium*: Prolobous, narrow. *Segmentation*: Secondary annulation present. Segments 1 and 2 fused (Fig. 21), with irregular longitudinal grooves. Segment 3 simple, as long as 1 + 2; 4–6 with 2 simple ringlets similar in size and appearance; 7–9 with 2 irregularly annulated ringlets,

second shorter than first; 10 and postclitellar segments randomly annulated; clitellar segments dorsally simple, ventrally with irregular annulation. *Setae*: Closely paired, minute; first pairs of *ab* on 4; *ab* = *cd*; postclitellarly *aa* < *bc* < *dd*; *dd* < $\frac{1}{2}$ u. *Nephridial pores*: Obvious on clitellar segments, less visible, small on other parts of the body; first pair on anterior part of segment 4, close to intersegmental furrow 3/4 much below *cd* setal lines; postclitellarly slightly below *cd* setal lines. *Female pores*: On segment 14, laterally, somewhat above ventral edges of clitellum. *Male pores*: On 18 in area of tubercula pubertatis, manifesting as small invaginations. *Spermathecal pores*: In 3 intersegmental furrows: 13/14 14/15 15/16, multiple, dorsolateral.

Clitellar region (Fig. 22): *Clitellum*: Saddle-shaped, segmented. Yellowish-brown in live specimens; alcohol-preserved: yellowish-white. On 12–22, clearly bordered anteriorly and posteriorly. Ventral edges about halfway between nephridial pores and *ab* setal lines. Ventrally not clearly bordered on segments 12–16 and 21–22. On 17–20 separated from tubercula pubertatis by clear, narrow rims. *Tubercula pubertatis*: In preserved material, broad rectangles with slightly rounded corners, segmented, on 17–20. Dorsal edges parallel to clitellar borders, ventral just above *ab* setal line. *Papillae*: Paired, associated with *ab* seta, various sizes. On 10–17 moderate swellings, on 18–19 prominent, on 22–29 eight pairs of well-developed tubercles, moderate in size, similar in appearance.

Internal characters:

Septa: 4/5 5/6, 7/8 8/9 9/10 thickened very little, elastic, not muscular, similar in size and appearance; 6/7 elastic, thickened less than 4/5. Other septa thin, firm. *Gizzard*: Barrel-shaped in 7, muscular, slightly softened posteriorly. In segment 6 there is soft crop. *Calciferous glands*: Paired, large, muscular, dorsolateral, in 10–11 with septum 10/11 apparently over middle of glands. Separated ventrally and dorsally. *Intestine*: Commences in 13. *Typhlosole*: Commences immediately with intestine, broad, 2-folded, wrinkled, posteriorly becoming thinner V-shaped. In holotype terminated in 153, in immature paratype in 157. *Dorsal blood vessel*: Undivided, simple over entire length. Thin in segments 4–7, in 8, 9,10 and posterior segments slightly enlarged. *Paired dorsoventral vessels*: 4–8 thin tubes, sometimes with moniliform structure, in 9–11 gradually enlarging, moniliform. *Oesophageal vessels*: Present. *Nephridia*: Meganephridia. One pair per segment of feathery coiled tubules with elongated, thick caeca. Postclitellar nephridia enlarged, not transparent.

Reproductive organs: *Spermiductal funnels*: Holandric arrangement. Two pairs of large, free, iridescent funnels in segments 10 and 11 respectively. Single arch-shaped structures of coagulum, probably congealed sperm, overlapping respectively each pair of male funnels, were observed in three clitellate paratypes. In juveniles coagulum was absent. *Vasa deferentia*: Two pairs of ducts proceed from lateral side of spermiductal funnels, and extend transversely before curving posteriorly to run backward, parallel to axis of the body. They extend through segments 10 and 11 separately, become close one to another in 12, fusing, and run to segment 18, where fused ducts enter body wall. *Seminal vesicles*: In holotype and clitellate paratypes 2 pairs of simple, smooth sacs commencing at septa 10/11 and 11/12 respectively. Anterior pair somewhat smaller than posterior pair and confined to segment 11. Posterior pair extended through segments 12 and 13. In non-clitellate specimens both

vesicles smooth, moderate in size and confined to segments 11 and 12 respectively. *Spermathecae*: Tiny, globular ampullae with necks embedded in body wall; 3–7 at each side, close to septa 13/14 14/15 15/16. *Ovaries*: Not observed. *Genital glands*: 16 pairs of moderate, variably sized, oval structures, associated with *ab* seta and corresponding with papillae, in 12–27.

Biological notes: Found in wet soil, between roots of indigenous plants covering swamp near the road. Juveniles were also present.

Distribution: Known only from the type locality in the Western Cape.

Discussion: Belongs to a group of holandric species with an extended posterior pair of seminal vesicles, three rows of spermathecae, and spermathecal pores in intersegmental furrows13/14–15/16 (*occiduus, ljungströmi*). Differs from the other species of this group in the size and shape of the spermathecae. *M. occidualis* has minute spermathecae embedded in the body wall; in *occiduus* and *ljungströmi*, spermathecae are large and not enclosed. The number and arrangements of papillae are characteristic for *occidualis*.

Microchaetus occiduus sp. n.

Figs 23–24

Etymology: L. *occiduus* = western. Another species from western South Africa.

Material examined: **Western Cape**: *Holotype* NMSA/Olig.02653, clitellate, 34 km NE Ceres (33°21'S:19°19'E), near road R 301, from sandy soil under short indigenous bushes, 12 August 1997. Paratypes: NMSA/Olig.02581, 10 clitellate, 11 juveniles collected together with holotype; NMSA/Olig.02584, 17 km N Ceres, near road R 303, from rocky, sandy soil on hillside with Proteas, 13 August 1997, 1 clitellate, 4 juveniles; NMSA/Olig.02589, 19 km N Ceres, near road R46, from rocky soil on hillside, 13 August 1997, 1 with absorbed clitellum, 7 juveniles; NMSA/Olig.02594, 9 km N Tulbagh (33°19'S:19°08'E), near road R44, from dry soil under indigenous bush, 4 clitellate, 11 juveniles. Other material: 17 km NE Vanrhynsdorp (31°37'S:18°44'E), De Kom, on bank of flowing river, from sandy soil, 16 August 1997, 3 specimens with tubercula pubertatis, NMSA/Olig.02617, 30 juveniles, NMSA/Olig.02618. All collected by JDP & TL.

Description based on holotype and paratypes.

External characters:

General: Body cylindrical. *Colour*: In life dorsally violet-grey, ventrally grey; alcohol-preserved: on preclitellar segments dorsally violet, ventrally whitish-grey. *Dimensions*: Holotype in life, slightly stretched 120 mm long; preserved and contracted 116 mm long, 5 mm at 10, 6 mm at tubercula pubertatis; paratypes preserved 90–125 mm long, 5 mm wide at 10, 6–8 mm at tubercula pubertatis. *Segment number*: Holotype 260, paratypes 198–296. *Prostomium*: Prolobous, small. *Segmentation*: Secondary annulation present. Segments 1 and 2 fused (Fig. 23), with no clear separation, with irregular longitudinal grooves; 3 simple, as long as 1 + 2; 4–6 with 2 simple ringlets similar in size and appearance; 7–9 with 2 irregularly annulated ringlets, second shorter than first; 10 and postclitellar segments simple;

clitellar segments dorsally simple, ventrally with irregular annulation. *Setae*: Closely paired, minute; first pairs of *ab* on 4; *ab* = *cd*; postclitellarly *aa* < *bc* > *dd*; *aa* < *dd*; *dd ca.* $\frac{1}{3}$ u; on some paratypes both rows of *dd* posteriorly converging. *Nephridial pores*: Obvious between clitellar segments; less noticeable on other parts of body; first pair much below *cd* setae in intersegmental furrow 3/4. *Female pores*: On segment 14, medially between *aa* setae, closely adjacent. M*ale pores*: On 18 in area of tubercula pubertatis, manifested by small invaginations. *Spermathecal pores*: In 3 intersegmental furrows: 13/14 14/15 15/16, much above clitellar ventral borders, close to nephridial pores.

Clitellar region (Fig. 24): *Clitellum*: Saddle-shaped, dorsally and laterally segmented. In alcohol-preserved specimens whitish-grey; clearly bordered anteriorly and posteriorly; first and last clitellar segments covered with much thinner layer of clitellar tissue; on segments 12,13–22,23. Ventral clitellar borders on segments 12,13–16 and 21–22,23 slightly above *ab* setal lines, touching median papillae; on segments 17–20 edges above tubercula pubertatis. *Tubercula pubertatis*: In preserved material flat glandular bands, trapezoidal with rounded corners, or oblong ovals; segmented, overlapping clitellar segments on 17–1/n20; dorsal edges much below nephridial pores, ventral borders parallel with ventral edges of clitellum. *Papillae*: Paired swellings associated with *ab* seta, on 10–23; anterior pairs of 10–14 usually combine with median segmental swellings; on 15–16 very small, on 17–20 more prominent, on 21–23 gradually diminishing.

Internal characters:

Septa: 4/5 5/6 6/7 thickened moderately, firm, similar in size and appearance; in some paratypes septa 7/8 and 8/9 were also slightly thickened, however, not equal to thickness of anterior septa; other septa thin, firm. *Gizzard*: In 7, cylindrical. *Calciferous glands*: Dorsolateral, in 10; separated ventrally and dorsally. *Intestine*: Commences in 13. *Typhlosole*: Commences immediately with intestine as thick W-shaped, ribbon-like tube; terminates in area of segments 132–149. *Dorsal blood vessel*: Undivided, simple along entire length; thin in segments 4–7, slightly enlarged in 8, 9,10 and posterior segments. *Paired dorsoventral vessels*: 4–8 thin tubes, sometimes with moniliform structure; in 9–11 gradually enlarging, moniliform. *Oesophageal vessels*: Present. *Nephridia*: Meganephridia; 1 pair per segment; tightly coiled tubules, each with elongated caecum which laterally turns backward, forming elongate J-shape, bringing curved end to nephridial pore; postclitellar nephridia much enlarged, not transparent.

Reproductive organs: *Spermiductal funnels*: Holandric arrangement. Two pairs of well-developed, large funnels observed in holotype and in 4 dissected paratypes. In other dissected paratypes size of funnels was variable; iridescence observed in both pairs confirms presence of sperm. In both segments floating sperm observed, clotted in 2 arch-shaped structures. *Vasa deferentia*: Two pairs ducts proceed from spermiductal funnels, and extend transversely before curving posteriorly to run backward, parallel to axis of the body. Both ducts of each pair run separately through 2 or more segments, becoming closer one to another in area of segments 12–15, and run to segment 18, where they unite before entering body wall in posterior part of segment 18, where there probably are male pores. *Seminal vesicles*: Two pairs sacs

commence at septa 10/11 and 11/12 respectively. Anterior pair consists of 2 elongated, club-shaped, smooth structures extending to segments 11 and 12; posterior pair commencing as 2 small pouches at septum 11/12, developing into pair of lobulated, pouched sacs, and extending backward through a few segments. Length, shape and size of extended pouches varies individually; some pouches extend only through 1 or 2 segments; others extend as far as segment 23,24 or beyond. In some specimens, extended backward pouches were twisted forward, bringing the last 2 or more pouches close to anterior pouches. *Spermathecae*: Club- or flask- or irregularly-shaped bladders, with slender ducts entering body wall near nephropores, close to septa 13/14 14/15 15/16; 2–4 at each side, partly filled with sperm, or empty. Empty parts of spermathecae usually transparent. *Ovaries*: Not observed. *Genital glands*: Moderate in size, oval structures associated with *ab* seta and corresponding with papillae, in 10–23.

Biological notes: Found in dry sandy soil, between roots of indigenous plants covering a rocky hillside, or under low bushes near road. Collected also from soaked sand at the side of a river. Associated with indigenous acanthodrilids. At one site, a large number of individuals were found together with one specimen of *Allolobophora trapezoides* (Dugès, 1828), an introduced species.

The different sizes and shapes of spermathecae, and also size and extension of seminal vesicles, could be associated with stages of maturity.

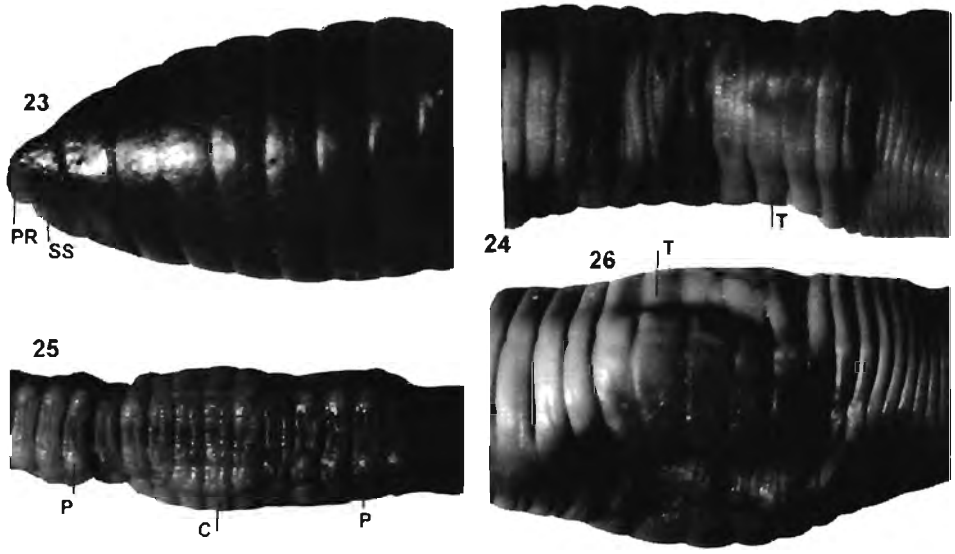
Distribution: Known from a few localities near the type locality in the Western Cape.

Discussion: Similar to my new species *occidualis* and *ljungströmi,* having spermathecae in intersegmental furrows 13/14–15/16 and posterior pair of seminal vesicles extended backwards. Differs in the shape and number of spermathecae per segment, and in the thickness of septa.

Microchaetus papillatus Benham, 1892

Microchaeta papillata Benham, 1892: 141.
Microchaeta papillata: Beddard, 1895: 672.
Microchaeta papillata nunc. *Microchaetus papillatus*: Reynolds & Cook, 1976: 50.
Microchaetus papillatus f. typicus Michaelsen, 1913*c*: 426.
Microchaetus papillatus cf. *Microchaeta papillata*: Reynolds & Cook, 1976: 50.
Microchaetus papillatus: Michaelsen, 1900: 450; 1907: 5; 1918: 320; Pickford, 1975: 23; Plisko, 1992: 345; 1993: 235.

Material examined: **KwaZulu-Natal**: Pietermaritzburg (29°35'S:30°25'E): from garden soil, December 1911, 1 clitellate, 2 juveniles, W. G. Rump, NMSA/ Olig.00646 & NMSA/Olig.00298; near road, 8 January, 1977, 1 juvenile, J. A. Huyssteen, NMSA/Olig.01341; Scottsville: Golf Field, 9 December 1991, 1 cocoon, JDP & A. Zicsi, NMSA/Olig.00308; on lawn, 17 January 1995, 1 juvenile, M. Coetzee, NMSA/ Olig.01999; on bank of Umsindusi river, from sandy soil, 8 January 1989, JDP, NMSA/Olig.00801; Bisley, on lawn, 29 October 1989, 1 juvenile, Ch. Shaw, NMSA/ Olig.00399; Cleland, collected by Ch. Shaw: on lawn, 1 clitellate, 3 juveniles, 25–27 October 1991, NMSA/Olig.01235 & NMSA/Olig.01236; 16 April 1992, 1 clitellate with regenerating segments, NMSA/Olig.01234; Hayfields, grassland, 1 juvenile, 1 October 1995, JDP, NMSA/Olig.02166; University gardens, 1 juvenile, 24 April 1995, L. Bourquin, NMSA/Olig.02000. Ashburton (29°40'S:30°28'E): from Dr T. Farkas' garden, collected on grassy surface, 10



Figs 23–26. *Microchaetus* species. 23–24. *M. occiduus* sp. n. 23. Anterior part of body with fused segments 1 and 2. 24. Clitellar region, ventral view. 25. *M. parvus* Michaelsen, 1913, clitellar region, ventral view with papillae and ventral edges of clitellum. 26. *M. pauli* sp. n., clitellar region, ventral view with tuberculum pubertatis. [PR = prostomium; SS = fused segments 1 and 2; T = tuberculum pubertatis; P = papilla.]

September 1990, 1 with absorbed clitellum, JDP, NMSA/Olig.002553; collected by T. Farkas: after rain on grassy surface, 2 specimens with absorbed clitellum, 9–27 October 1990, NMSA/Olig.00334 & NMSA/Olig.00335; on grassy surface, 2 clitellate, 1 with absorbed clitellum, 1 November 1990, NMSA/Olig.00336; from garden, 21 October 1991, 7 clitellate, 1 juvenile, NMSA/Olig.01238; on surface, 25 October 1991, 1 clitellate, NMSA/Olig.01237. Sunset Road, after rain, 15 October 1997, 7 clitellate, 4 juveniles, JDP, NMSA/Olig.02649. Durban, Stella Bush [Pigeon Valley, 29°51'S:30°59'E], 1 juvenile, [no more data known], NMSA/Olig.00299. 22 km W Scottburgh [30°16'S:30°45'E], April 1976, 3 clitellate, NMSA/Olig.01337.

The original description (Benham 1892) and subsequent redescriptions (Michaelsen 1913*c*; Plisko 1992) provide a comprehensive basis for identification of this species. It can only be added that the typhlosole commences in segment 14, and terminates in the area of segment 300.

Distribution: Known only from a restricted area of Durban and Pietermaritzburg. Found mainly in grasslands, bushes and other undisturbed biotopes, but also in lawns, sports-fields, greens and other places which undergo partial surface disturbance.

Microchaetus parvus Michaelsen, 1913

Fig. 25

Microchaetus parvus Michaelsen, 1913*c*: 445; Michaelsen, 1918: 331; Reynolds & Cook, 1976: 152; Plisko, 1991*a*: 279; 1992: 349; 1993*b*: 235.

Material examined: **KwaZulu-Natal**: Collected by JDP: Umtamvuma Nature Reserve (31°00'S:30°09'E) from sandy soil between roots, 23 May 1989, 1 clitellate

NMSA/Olig.00900; Thornville (29°44'S:30°24'E) from top soil of cultivated field, 9 January 1989, 1 clitellate and 14 juveniles, NMSA/Olig.00810; Albert Falls (29°26'S:30°24'E), Bon Accord Holiday Resort, from dry soil of grassland, 6 March 1991: 1 clitellate NMSA/Olig.00894, 2 clitellate NMSA/Olig.00871, 5 with tubercula pubertatis NMSA/Olig.00858. Collected by JDP & TL: 18 km SE Bergville (28°43'S:29°21'E), primary grassland near R74, 5 December 1996, 14 clitellate, 10 juveniles NMSA/Olig.02444; 27 km SE Bergville, from primary grassland near R74, 5 December 1996, 1 clitellate and 6 juveniles, NMSA/Olig.02445; Mooiriver (29°12'S:30°01'E), from moist soil, primary grassland near road M3, 5 December 1996, 4 clitellate NMSA/Olig.02450; 20 km E Melmoth (28°35'S:31°23'E), near road, from moist soil between roots of tall grasses, 16 December 1995, 4 clitellate NMSA/Olig.02301. Near Estcourt (29°00'S:29°52'E), Rensburg Spruit Farm, from garden soil, 21 December 1995, D. Green, 2 clitellate NMSA/Olig.02202. **Mpumalanga**: Genezareth Camp near Lake Chrissie (26°18'S:30°13'E), from moist soil of undisturbed ground close to lake, 5 December 1995, JDP & TL, 2 clitellate, 5 juvenile, NMSA/Olig.02214; 5 km W Carolina (26°04'S:30°07'E), from moist sandy soil under burned grasses, 6 December 1995: 2 clitellate with anterior segments damaged by parasites NMSA/Olig.02303, 9 clitellate, 7 juveniles NMSA/Olig.02220, 1 cocoon NMSA/Olig.02338, JDP & TL.

Distribution: Recorded widely in KwaZulu-Natal (Plisko 1991*a* 1992), and in Mpumalanga.

Discussion: The redescription of the holotype by Plisko (1991*a*) matches this new material, although in some individuals the clitellum was observed extending to segment 23 (Fig. 25), and the dorsal blood vessel can be doubled in segments 5–6. The typhlosole commences in the area of segment 18. The two spermiductal funnels are clearly visible in all mature specimens, confirming this species to be holandric.

During the process of preservation, when the worms from Carolina were in 45 % ethyl alcohol, two small insect larvae were seen to emerge from the area of the third segment of one specimen. Close examination revealed that the first few segments were damaged in a manner similar to that caused by parasitic larvae of the calliphorid fly *Pollenia rudis* (Fabricius, 1794) in *Allolobophora* species in Europe. Prof. A. Draber of the Institute of Zoology in Warsaw identified the larvae as Diptera. This is the first record of parasitic dipterous larvae in South African earthworms.

Microchaetus pauli sp. n.

Fig. 26

Etymology: Named for my cousin Paul Michalak, who always shows interest in my study of earthworms.

Material examined: **Western Cape**: *Holotype* NMSA/Olig.02619, clitellate, 20 km W Vanrhynsdorp (31°37'S:18°44'E), on top of the hill De Kom, from moist sandy soil, 16 August 1997. Paratypes: from type locality, collected with holotype, NMSA/Olig.02620, 2 clitellate complete, 1 abscised. All material collected by JDP & TL.

Description based on holotype and paratypes.

External characters:

General: Body cylindrical. *Colour*: In life dorsally violet-dark grey, ventrally light grey; alcohol-preserved: dorsally dark grey with violet tint on preclitellar segments, ventrally whitish-grey. *Dimensions*: Holotype in life, slightly stretched 200 mm long; preserved and contracted 160 mm long, 6 mm wide at 10, 10 mm at tubercula pubertatis; paratypes preserved 142–182 mm long, 5–6 mm wide at 10, 9–10 mm at tubercula pubertatis. *Segment number*: Holotype 433, paratypes 292–406. *Prostomium*: Prolobous, small, inverted into body cavity. *Segmentation*: Secondary annulation present. Segments 1 and 2 fused, with no clear separation, with irregular longitudinal grooves: 3 simple, as long as 1 + 2; 4–7 with 2 simple ringlets similar in size and appearance; 8–9 with 2 ringlets, second shorter than first; 10 and postclitellar segments simple; clitellar segments simple, longer than postclitellar. *Setae*: Closely paired, minute; *ab* = *cd*; postclitellarly *aa* < *bc* < *dd* < $\frac{1}{2}$u; first pairs of *ab* on 4. *Nephridial pores*: Small; obvious in intersegmental furrows on some preclitellar and clitellar segments; first pair in intersegmental furrow 3/4, near *cd* setal lines. *Female pores*: On segment 14, above *b* setal lines. *Male pores*: In intersegmental furrow 19/20 in area of tubercula pubertatis, where there are small invaginations. *Spermathecal pores*: In 6 intersegmental furrows: 11/12 12/13 13/14 14/15 15/16 16/17, near nephridial pores; multiple.

Clitellar region (Fig. 26): *Clitellum*: Saddle-shaped, dorsally segmented, with segments much longer than preclitellar or postclitellar segments. In alcohol-preserved specimens whitish-grey; clearly bordered anteriorly and posteriorly, on 12–28; on 12–16 and 25–28 ventral edges at extension of ventral borders of tubercula pubertatis; on 17–24 bordering above tubercula pubertatis. *Tubercula pubertatis*: Rectangles rounded at corners, segmented, flat, smooth; on 17–23,24; dorsally below clitellar edges, separated from clitellum by narrow rims; ventral borders parallel with *ab* setal lines. *Papillae*: Paired tiny swellings, associated with *ab* seta, on 10–28.

Internal characters:

Septa: 4/5 5/6, 7/8 8/9 thickened, muscular, elastic, firm, similar in size and appearance; 6/7 and 9/10 thin, firm; other septa thin. *Gizzard*: In 7, cylindrical, softened posteriorly. *Calciferous glands*: Dorsolateral, in 10; separated dorsally and ventrally. *Intestine*: Commences in 12. *Typhlosole*: Commences immediately with intestine as thick, three-folded structure, gradually extending, and in area of 25 changing into large U-shaped tube; in paratypes terminates in segments 230–238. *Dorsal blood vessel*: Undivided, simple, over entire length; in 4–7 thin tube, in 8 enlarged simple, in 9 enlarged, resembling cordiform organ. *Oesophageal vessels*: Present, commence in anterior segments, extending to area of calciferous glands in segment 10. *Paired dorsoventral vessels*: 4–8 thin tubes, sometimes with moniliform structure; 9–11 gradually enlarging, moniliform hearts. *Nephridia*: Meganephridia; 1 pair per segment. In postclitellar segments tightly coiled median tubules, with elongated caecum, which turns back, forming J-shaped tube, terminating dorsally at a nephridial pore.

Reproductive organs: *Spermiductal funnels*: Holandric arrangement (in segments 10 and 11); in holotype and one dissected paratype both pairs well developed; in

other paratype a pair of segment 10 was smaller than pair of segment 11; iridescence confirming presence of sperm was noted in both pairs. *Vasa deferentia*: Two pairs of ducts commence in segments 10 and 11 respectively, on lateral side of spermiductal funnels, and extending transversely before curving posteriorly to run backward, parallel to axis of body. Initially separated, both ducts run backward separately, although close one to another, to segment 18, where they unite before entering body wall at intersegment 19/20, where there are male pores. *Seminal vesicles*: Only a single pair of dorsolateral sacs observed, commencing posteriorly to anterior pair of spermiductal funnels at septum 10/11. In holotype, sacs of right and left side were irregularly lobulated, different in size and appearance, and extended at right side to segment 17, at left side to segment 15. In paratypes, lobular sacs extended into smooth ends, and stretched to segments 15, or 16, sometimes twisting forwards. *Spermathecae*: In segments 12–16, near septa 11/12–16/17. Tiny globular ampullae, with very thin necks deeply embedded in body tissue; the number of ampullae varies in the rows; in holotype1–4 ampullae at each side, in paratypes 1–8. In 2 anterior segments usually 1–2 ampullae, in following segments 2–8 ampullae. Iridescence observed in majority of ampullae confirms presence of sperm. *Ovaries*: Not observed. *Genital glands*: Oval, small to moderate bladders, associated with *ab* seta, and corresponding with papillae, in segments 10–33.

Biological notes: Found in moist, sandy soil on summit of the Matsikammaberge. Occurs between roots of various plants covering rocky hillside. There is no doubt about bisexual reproduction, as iridescence was observed in spermathecae, confirming the exchange of sperm between two individuals.

Distribution: Known only from the type locality in Namaqualand.

Discussion: Similar to my new species *imitatus* and *senarius*. All three species are characterised by multiple, small spermathecae, have spermathecal pores in six intersegmental furrows 11/12–16/17, and have one pair of seminal vesicles extended backward. In two of the species an absence of one pair of seminal vesicles occurs. In *imitatus* this reduction is confined to an anterior pair of seminal vesicles, in *pauli* a posterior pair is reduced; in *senarius* both pairs are present, although the posterior pair is extended backward. These species differ in the position of the clitellum and shape of the tubercula pubertatis.

Microchaetus pearsonianus Pickford, 1975

Microchaetus pearsonianus Pickford, 1975: 31–37.
Microchaetus pearsonianus: Reynolds & Cook, 1976: 153; Plisko, 1993*b*: 235–236.

Material examined: **Western Cape**: *Holotype*, SAM.21544, Cape Peninsula, National Botanic Gardens, Kirstenbosch (34°00'S:18°25'E), in soggy sandy soil at depth of 18 inches to 2 feet below lawn, 29 October 1925, coll. G. E. Pickford. Other material: Cape Peninsula, Paradise Estate, near Kirstenbosch, open grassy slope by stream, below Lady Anne Barnard's ruined cottage, very wet and boggy soil raised in mounds, 16 June 1926, coll. G. E. Pickford, 1 specimen well preserved, not fully mature.

An earlier dissection and internal examination left both specimens in poor

condition, decomposed and with incomplete internal organs. Pickford (1975) stated that only septa 4/5 5/6 6/7 are strongly thickened in this species. I found also septa 7/8 and 8/9 thicker than those of the posterior segments, although much thinner than 4/5 5/6 6/7 which are thickened very much and are conical.

Calciferous glands encircling oesophagus laterally and ventrally, as stated in the original description, separated dorsally by a narrow groove. Dorsal blood vessel undivided, thin in segments 4–7, enlarged in 8 and 9, in the following segments thick. Due to decomposition of intestine, its commencement in segment 14 (a position rather rare in microchaetids) cannot be confirmed.

Microchaetus pentus sp. n.

Figs 27–29

Etymology: G. *pente* = five. Refers to the five rows of spermathecae.

Material examined: **Western Cape**: *Holotype* NMSA/Olig.02605, clitellate, 17 km N Citrusdal (32°36'S:19°01'E), near road N7, open veld, 14 August 1997. Paratypes collected together with holotype: NMSA/Olig.02672, 4 clitellate, 2 juveniles. All material collected by JDP &TL.

Description based on holotype and paratypes.

External characters:

General: Body cylindrical. *Colour*: In life dorsally violet-dark grey, ventrally grey; alcohol-preserved: dorsally and ventrally grey. *Dimensions*: Holotype preserved and contracted 106 mm long, 3 mm wide at 10, 6 mm at tubercula pubertatis; paratypes preserved 105–115 mm long, 3 mm wide at 10, 5–6 mm at tubercula pubertatis. *Segment number*: Holotype 329. *Prostomium*: Epilobous. *Segmentation*: Secondary annulation present on preclitellar segments. Segments 1 and 2 fused (Fig. 27), with irregular longitudinal grooves; 3 simple, as long as 1 + 2; 4–7 with 2 simple ringlets similar in size and appearance; 8–9 with 2 ringlets, second shorter than first; 10 and postclitellar segments simple; clitellar segments dorsally simple, ventrally with irregular annulation. *Setae*: Closely paired, minute; *ab* = *cd*; postclitellarly *aa* < *bc* > *dd*; *dd* < $\frac{1}{2}$u; first pairs of *ab* on 4. On segments 10–16 diverging, on 17–23 with similar distances, on 24–29 converging. *Nephridial pores*: Small; clearly visible on clitellar segments; first pair in intersegmental furrow 3/4 much below *cd* setal lines. Postclitellarly not visible. *Female pores*: Probably on segment 14. *Male pores*: Probably in intersegmental furrow 18/19 or posterior part of segment 18 in area of tubercula pubertatis, as vasa deferentia enter body wall. *Spermathecal pores*: In 5 intersegmental furrows: 11/12 12/13 13/14 14/15 15/16, at the clitellar ventral borders, close to nephridial pores, difficult to observe.

Clitellar region (Fig. 28): *Clitellum*: Saddle-shaped, segmented; in alcohol-preserved specimens white. On 12–25; ventral borders of 12–16 parallel with rows of *ab* setae; on 17–26 just above tubercula pubertatis. *Tubercula pubertatis*: in preserved material as flat bands, oblong, rounded at corners, segmented; overlapping clitellum on 17–23; dorsal borders below nephridial pores, ventral at

edges of clitellum. *Papillae*: Paired swellings associated with *ab* seta; on 10–16 moderate, on 17–22 tiny; on 23–29 small, gradually diminishing in size.

Internal characters:

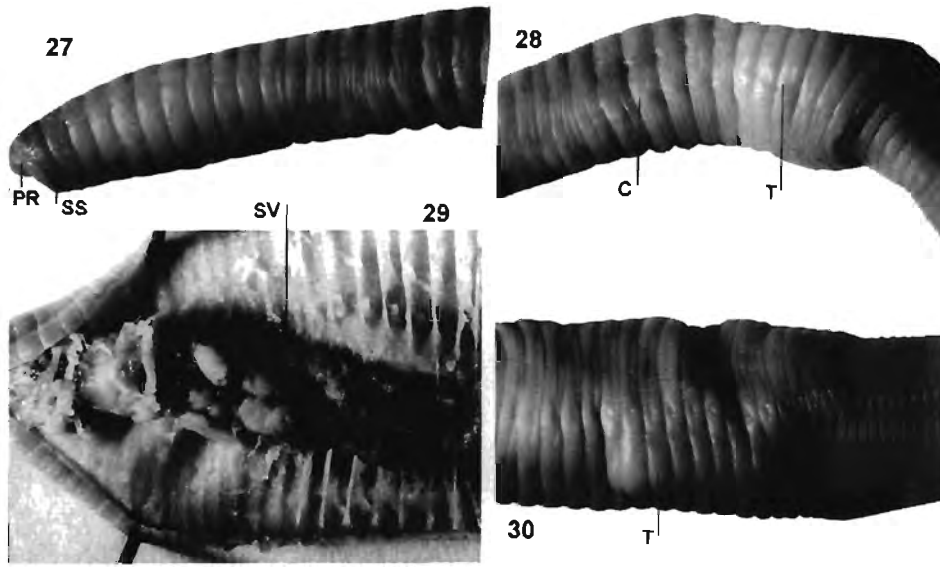
Septa: 4/5 5/6, 7/8 8/9 thickened moderately, firm, similar in size and appearance; 6/7 and 9/10 slightly thickened, much thinner than anterior; other septa thin, firm. *Gizzard*: In 7, bell-shaped, softened posteriorly. *Calciferous glands*: Dorsolateral in 10; separated ventrally and dorsally. *Intestine*: Commences in 13. *Typhlosole*: Commences together with intestine as twice-folded, gradually extending into U-shape; terminates in area of segment 186. *Dorsal blood vessel*: Undivided, simple over entire length; in 4–7 as thin tube; in 8–9 enlarged; 10 and the following enlarged. *Paired dorsoventral vessels*: 4–8 thin tubes, sometimes with moniliform structure; 9–11 gradually enlarging, moniliform. *Oesophageal vessels*: Present. *Nephridia*: Meganephridia; 1 pair per segment. In segments 6–30 tightly coiled tubules with elongated caecum turning dorsolaterally into J-shape; the shorter top-end of caecum enters nephridial pore. Postclitellar nephridia much thicker, containing fatty tissue.

Reproductive organs: *Spermiductal funnels*: Holandric arrangement; 2 pairs funnels, well developed, iridescent, in segments 10 and 11. In both segments floating sperm observed. *Vasa deferentia*: Two distinct ducts at each side of body commence in segments 10 and 11 on lateral side of spermiductal funnels. Both ducts extend transversely before curving posteriorly to run backward, parallel to axis of body, and run backward through 1 or 2 segments separately. In area of segments 12–14 they come close together and run to segment 18, fusing and entering body wall at intersegment 18/19, at male pores. *Seminal vesicles*: Two pairs of sacs commence at septum 10/11 and 11/12 respectively; anterior pair confined to segment 11; posterior pair gradually enlarging and extending to segments 12–14,15 (Fig. 29). *Spermathecae*: In segments 12–16, near to septa 11/12–15/16. Tiny globular bladders of various sizes, with thin necks embedded in body tissue; 1–4 on each side; in holotype 2 pairs spermathecae observed in anterior segment; in other segments there were 4 pairs; in paratypes number of spermathecae per row varies from 1 to 6. *Ovaries*: Irregularly shaped funnels attached to anterior part of segment 13. *Genital glands*: Variously sized oval structures, associated with *ab* seta and corresponding with papillae; small to moderate.

Biological notes: Found in moist soil, between roots of various plants. The juveniles found together with fully mature clitellate specimens indicate development during the rainy season. Sperm was observed in a few spermathecae.

Distribution: Known only from type locality in the Western Cape.

Discussion: Similar to my new species *alipentus*; both species have the same general appearance, and are characterised by possession of five rows of spermathecae in segments 12–15, with spermathecal pores in intersegmental furrows 11/12–15/16. In *alipentus*, however, a reduction of the posterior pair of seminal vesicles was observed. The species differ also in the shape of the prostomium which in *pentus* it is epilobous, and in *alipentus* prolobous.



Figs 27–30. *Microchaetus* species. 27–29. *M. pentus* sp. n. 27. Anterior part of body with fused segments 1 and 2, and preclitellar annulation. 28. Clitellar region, dorsolateral view. 29. Dorsally dissected part of body. 30. *M. senarius* sp. n., clitellar region, ventral view. [PR = prostomium; SS = fused segments 1 and 2; C = clitellum; T = tuberculum pubertatis; SV = posterior seminal vesicle.]

Microchaetus pondoanus Michaelsen, 1913

Microchaetus pondoanus var. *typica* Michaelsen, 1913*a*: 542.
Microchaetus pondoanus Michaelsen, 1913*a* var. *minor* Michaelsen, 1913*a*: 547; Reynolds & Cook 1976: 137.
Microchaetus pondoanus: Pickford 1975: 23; Reynolds & Cook 1976: 157; Plisko 1992: 339.

Material examined: **KwaZulu-Natal**: Collected by S. F. du Plessis: 4 km E Port Edward (31°03'S:30°13'E), in coastal forest, 21 April 1976, 8 specimens, NMSA/Olig.01329; Port Edward, 4 May 1977, 8 specimens, NMSA/Olig.01330; 21 April 1976, 1 specimen infested with parasites, NMSA/Olig.01331. Collected by F. van der Merwe: South Coast, Bayzlee Beach (30°26'S:30°40'E), at the end of trail leading from dune vegetation, 3 June 1994, 1 clitellate, NMSA/Olig.01412. Umtamvuma Nature Reserve (31° 00'S:30°09'E): from litter, 22 November 1995, 2 clitellate, NMSA/Olig.02197, collected by D. Herbert; near Old Pont, Kingfisher Trail, from litter, 18 November 1997, 2 clitellate, NMSA/Olig.02665; Mpenjati (30°58'S:30°17'E), Yengele Trail, dune forest, from litter, 19 November 1997, NMSA/Olig.02666, collected by S. James & K. Cradock.

In his description of this species, Michaelsen (1913*a*) named individuals with the clitellum on segments 12–20 as *pondoanus* forma *typica*; in the same paper the only immature individual with clitellum on segments 12–19 was named 'varietas *minor*'. In the material recorded above, I have noted that on young specimens the clitellum is usually slightly less developed on segment 20.

Distribution: Known from a limited area of the north-eastern Eastern Cape (formerly known as Transkei), and from south-eastern KwaZulu-Natal.

Microchaetus senarius sp. n.

Fig. 30

Etymology: L. senarius = consisting of six. Refers to the six rows of spermathecae.

Material examined: **Western Cape**: *Holotype* NMSA/Olig.02667, clitellate, 18 km SE Porterville (33°00'S:19°00'E), from ditch near road R44, 13 August 1997. Paratypes: from type locality, collected with holotype, 2 not fully mature specimens, NMSA/Olig.02671; 17 km NW Porterville from ditch near road R44, 13 August 1997, 1 clitellate, NMSA/Olig.02598. All material collected by JDP & TL.

Description based on holotype and paratypes.

External characters:

General: Body cylindrical. *Colour*: In life dorsally violet-dark grey, ventrally light grey; alcohol-preserved: dorsally dark grey with violet tint; ventrally grey. *Dimensions*: Holotype preserved and contracted 105 mm long, 5 mm wide at 10, 7 mm at tubercula pubertatis; paratypes preserved 92–102 mm long, 5 mm wide at 10, 6–7 mm at tubercula pubertatis. *Segment number*: Holotype 261, paratypes 183+ to 236. *Prostomium*: Prolobous, small. *Segmentation*: Secondary annulation present on preclitellar segments. Segments 1 and 2 fused, with irregular longitudinal grooves; 3 simple, as long as 1 + 2; 4–7 with 2 simple ringlets similar in size and appearance; 8–9 with 2 ringlets, second shorter than first; 10 and postclitellar segments simple; clitellar segments simple. *Setae*: Closely paired, minute; *ab* = *cd*; postclitellarly *aa* < *bc* < *dd* < $\frac{1}{2}$u; first pairs of *ab* on 4. *Nephridial pores*: Not observed. *Female pores*: Not observed. *Male pores*: Probably in intersegmental furrow 18/19, where vasa deferentia enter body wall. *Spermathecal pores*: In 6 intersegmental furrows: 11/12 12/13 13/14 14/15 15/16 16/17, near nephridial pores; multiple.

Clitellar region (Fig. 30): *Clitellum*: Saddle-shaped, not clearly demarcated, yellowish-grey, with very thin layer of clitellar tissue. On 12–26, separated from tubercula pubertatis by narrow rims. *Tubercula pubertatis*: Oblong, broad bands, segmented; on 1/n17–23,24; dorsally below clitellar edges, rimmed dorsally and ventrally; ventral borders just above *ab* setae. *Papillae*: Paired swellings, associated with *ab* seta, on 10–30,31.

Internal characters:

Septa: 4/5 5/6 thickened moderately, 7/8 8/9 more thickened, similar in size and appearance; 6/7, 9/10 and other septa thin. *Gizzard*: In 7, barrel-shaped. *Calciferous glands*: Dorsolateral, in 10, separated dorsally and ventrally. *Intestine*: Commences in 12. *Typhlosole*: Commences immediately with intestine as broad, thick tube; in holotype terminates in 156. *Dorsal blood vessel*: Undivided, simple, over its whole length; in 4–7 thin tube, in 8–9 slightly enlarged, simple. *Oesophageal vessels*: Present, commence in anterior segments, extending to area of calciferous glands in segment 10. *Paired dorsoventral vessels*: 4–8 thin tubes, sometimes moniliform; 9–11 gradually enlarging, moniliform hearts. *Nephridia*: Meganephridia; 1 pair per segment. Coiled, elongate loops, with elongated J-shaped tubules.

Reproductive organs: *Spermiductal funnels*: Holandric arrangement. Two pairs well-developed, iridescent funnels in segments 10 and 11 respectively. *Vasa*

deferentia: Two pairs of ducts commence in segments 10 and 11 respectively on lateral side of spermiductal funnels, and extend transversely before curving posteriorly to run backward, parallel to axis of body. Both ducts run separately to segment 12 where they come close together and run to posterior part of segment 18, fusing and entering body wall at intersegment 18/19. *Seminal vesicles*: Two pairs vesicles, commencing posterior to septa 10/11 and 11/12 respectively; anterior pair confined to segment 11; posterior pair extends bulging through segments12–14,15. In one individual both pairs lobulated, small and conical. *Spermathecae*: In segments 12–16, near septa 11/12–16/17. Small globular ampullae, with very thin necks, deeply embedded in body tissue. Number of ampullae varies from 1–7 at each side, and differs in different individuals. Iridescence noted in spermiductal funnels and in some of ampullae confirms presence of sperm. *Ovaries*: Not observed. *Genital glands*: Oval, small to moderate bladders, associated with *ab* seta, and corresponding with papillae; in segments 9–30,31,32.

Biological notes: Found in moist sandy soil in a ditch surrounded by fynbos. Occurs between roots of various plants. Presence of sperm in the spermiductal funnels and spermathecae indicates bisexual activity at the beginning of spring.

Distribution: Known only from the type locality in the Western Cape.

Discussion: Similar to my new species *pauli* and *imitatus.* All three species are similar in general appearance, although the position of the clitellum varies. They are characterised by six rows of multiple, small spermathecae in six segments, spermathecal pores in intersegmental furrows 11/12–16/17, and two pairs of seminal vesicles. However, in *imitatus* and *pauli* an anterior or a posterior pair of seminal vesicles is reduced, with simultaneous retention of both pairs of testes and spermiductal funnels. It is possible that the condition in *pauli* and *imitatus* is derived from that in *senarius.*

Microchaetus tuberosus sp. n.

Fig. 31–32

Etymology: L. *tuberosus* = full of lumps, swellings. Refers to the numerous papillae.

Material examined: **KwaZulu-Natal**: *Holotype* NMSA/Olig.00889, clitellate, Oribi Gorge Nature Reserve (30°42'S:30°16'E), at *ca.* 50 m, riverine bush on bank of Mzinkulwana River, from moist sandy soil under stones, 22 May 1989. Paratypes: collected together with holotype, 12 clitellate and 3 juveniles, NMSA/Olig.00890. Other material: at edge of sugar cane field bordering Oribi Gorge Nature Reserve, from moist, sandy soil, 2 clitellate, 2 with tubercula pubertatis, 10 juveniles, 1 abscised at anterior segments, 22 May 1989, NMSA/Olig.00222. All collected by JDP.

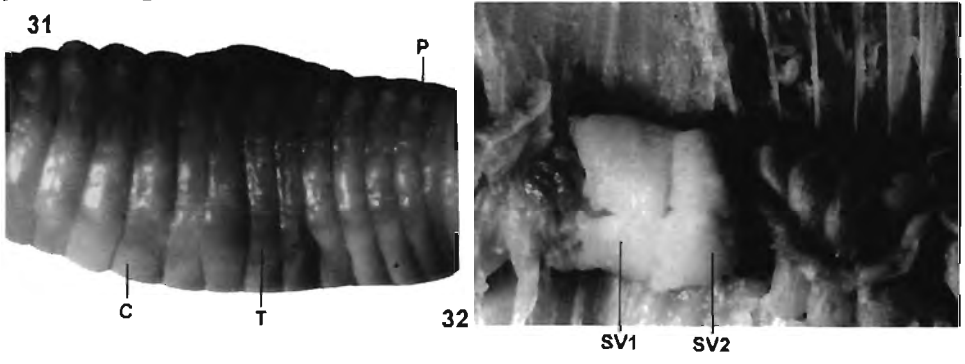
Description based on holotype and paratypes.

External characters:

General: Body cylindrical. *Colour*: In life dorsally violet, ventrally yellowish-grey; alcohol-preserved: yellowish-white, not showing pigmentation. *Dimensions*: Holotype somewhat extended during preservation, 94 mm long, 3 mm wide at 10, 4 mm at

tubercula pubertatis; paratypes 86–92 mm. *Segment number*: Holotype 186; paratypes 186–214. *Prostomium*: Prolobous, small. *Segmentation*: Secondary annulation present. Segment 1 and 2 simple, short, with irregular longitudinal grooves; 3 simple; 4–8 with 2 simple ringlets similar in size and appearance; 9 with 2 simple ringlets, second shorter than first; 10 and following segments simple; postclitellarly irregularly annulated. *Setae*: Moderate in size; *ab* paired distantly, *cd* closely; *ab* > *cd*, *aa* > *bc*; on segments 10–23 or 10–27 *ab* setae associated with papillae; first pair of *ab* setae on 2; on annulated segments setae always on first ringlet. *Nephridial pores*: In *cd* setal lines; first pair in 3/4 intersegmental furrow. *Female pores*: Not observed, probably embedded in wall tissue of segment 14. *Male pores*: In intersegmental furrow 14/15 on anterior part of tubercula pubertatis, where there are small invaginations. *Spermathecal pores*: In intersegmental furrows 12/13 and 13/14, with minute swellings.

Clitellar region (Fig. 31): *Clitellum*: Well developed on 13–22; clearly bordered anteriorly and posteriorly, segmented, yellowish-white; lateral edges irregular, extending slightly above *c* setal lines. *Tubercula pubertatis*: Irregular, elongate swellings below ventrolateral clitellar margins; segmented, rimmed; on 1/n14,15–18; on some paratypes most glandular tissues occur on segment 16. *Papillae*: Prominent, moderate swellings associated with both *ab* setae, or only with *a* or *b*; on 10–22,23 or extending to 27; on 10–14 and 19–22,23 or 19–27 usually larger than on 15–18; paired or single.



Figs. 31–32. *M. tuberosus* sp. n. 31. Clitellar region, ventral view. 32. Dorsally dissected preclitellar part of body. [C = clitellum; T = tuberculum pubertatis; P = papilla; SV1 = anterior pair of seminal vesicle; SV2 = posterior pair of seminal vesicle.]

Internal characters:

Septa: Septum 4/5 thickened, slightly muscular; 7/8 8/9 thickened moderately, firm, similar in size and appearance, although sometimes posterior septum can be slightly thinner; other septa firm. *Gizzard*: Barrel-shaped, muscular, in 7; softened posteriorly. *Calciferous glands*: In 9–10; reniform, paired, separated ventrally and dorsally; connected with oesophagus by short, thin stalk. *Intestine*: Commences in 12 or 13. *Typhlosole*: Commences in 19 as thick V-shaped tube, posteriorly extending into ribbon-like or thick U-shaped tube; terminates in holotype in 135. *Dorsal blood vessel*: Single in 5–6 or only in 5; in 6–7 double, close; in 8 double, separated; in 9 cordiform; single when crossing septa; single in 10 and following segments. *Paired*

dorsoventral vessels: 5–8 simple, thin tubes, 9–11 gradually enlarging, moniliform. *Oesophageal vessel*: Present. *Nephridia*: Meganephridia; 1 pair per segment; coiled long, thin loops with short V-shaped caeca.

Reproductive organs: *Spermiductal funnels*: Holandric arrangement. Two pairs moderate funnels, enclosed in separated sacks, commence at posterior part of segments 10 and 11 respectively. *Vasa deferentia*: Not observed, covered by thick tissue of body wall. *Seminal vesicles* (Fig. 32): Commencing at posterior part of septa 10/11 and 11/12 respectively, extend dorsolaterally as single sacs to segments 10 and 11; similar in size, although in some individuals a posterior sac can be slightly larger, and extending septum 11/12 expands to segment 12. *Spermathecae*: In 2 rows, close to septa 12/13 and 13/14. Tubular, bent or serpentine, 1 pair in anterior segment, 2 pairs in posterior segment, similar in size. In holotype sperm observed only in 1 spermatheca, the other ampullae were much smaller and empty; in paratypes sperm observed in all 4 spermathecae. *Ovaries*: Not observed; probably in posterior part of 13, covered by nephridial loops and septal tissue. *Genital glands*: In 15–18, paired, associated with *ab* setae and papillae; small, flat, deeply embedded in body wall. *Genital setae*: Present in segments incorporating papillae.

Biological notes: Found in the southern KwaZulu-Natal hinterland. Collected from moderately moist soil on riverbank in Oribi Gorge Nature Reserve and in its neighbourhood on the border of a sugarcane plantation. Associated with an exotic species *Pontoscolex corethrurus* (Müller, 1856), which was probably introduced during cultivation of sugar cane.

Distribution: Known only from the type locality and its close neighbourhood in southern KwaZulu-Natal.

Discussion: A fairly distinctive species, although showing similarity to a group of species with multiple spermathecae, spermathecal pores in intersegmental furrows 12/13 13/14, paired calciferous glands, and dorsal blood vessel doubled in some preclitellar segments. It differs in the position of the clitellum and enclosure of seminal vesicles in two single sacs.

Microchaetus vernoni Plisko, 1992

Microchaetus vernoni Plisko, 1992: 349; Plisko 1993*a*: 235; Reynolds & Cook 1993: 22.

Material examined: **KwaZulu-Natal**: Umzinto [30°16'S:30°41'E] bush, 1921, H. W. Bell-Marley, 1 clitellate, NMSA/Olig.00301. Collected by JDP: Vernon Crookes Nature Reserve (30°16'S:30°35'E) primary grassland, excavated by bulldozer, 23 November 1989, 1 immature specimen, NMSA/Olig.00754; 5 abscised juveniles, NMSA/Olig.00755.

External and internal characters are in accord with the original description (Plisko,1992). In the above material, not previously studied, a small degree of individual variation in the thickness of septa was noted, possibly related to the degree of maturity. It was also not previously observed that a typhlosole commences in segment 13 together with the intestine. Oesophageal vessels are present in this species, though this characteristic was not recorded in the original description.

TABLE 1

Microchaetus species arranged according to the number of intersegmental furrows (NIF) with spermathecal pores. Species marked with an asterisk extend one pair of seminal vesicles.

NIF	*9/10*	*10/11*	*11/12*	*12/13*	*13/14*	*14/15*	*15/16*	*16/17*	*spec. name*
1	–	–	–	+	–	–	–	–	*pondoanus*
1	–	–	–	–	+	–	–	–	*zaloumisi*
2	–	–	+	+	–	–	–	–	*caementerii*
2	–	–	–	+	+	–	–	–	*montanus*
2	–	–	–	+	+	–	–	–	*pentheri*
2	–	–	–	+	+	–	–	–	*ritae*
2	–	–	–	+	+	–	–	–	*rivus*
2	–	–	–	+	+	–	–	–	*tuberosus*
2	–	–	–	–	+	+	–	–	*natalensis*
2	–	–	–	–	+	+	–	–	*parvus*
3	+	+	+	–	–	–	–	–	*namaensis*
3	–	–	+	+	+	–	–	–	*madidus*
3	–	–	–	+	+	+	–	–	*decipiens*
3	–	–	–	+	+	+	–	–	*ambitus*
3	–	–	–	+	+	+	–	–	*vernoni*
3	–	–	–	–	+	+	+	–	*franciscus*
3	–	–	–	–	+	+	+	–	*guntheri*
3	–	–	–	–	+	+	+	–	*ljungströmi**
3	–	–	–	–	+	+	+	–	*metandrus**
3	–	–	–	–	+	+	+	–	*occidualis**
3	–	–	–	–	+	+	+	–	*occiduus**
3	–	–	–	–	+	+	+	–	*pearsonianus**
4	–	–	–	+	+	+	+	–	*hamerae**
4	–	–	–	+	+	+	+	–	*rosai**
4	–	–	–	+	+	+	+	–	*circulatus*
4	–	–	–	+	+	+	+	–	*davidi*
4	–	–	–	+	+	+	+	–	*microchaetus*
4	–	–	–	+	+	+	+	–	*papillatus*
4	–	–	–	–	+	+	+	+	*crousi*
5	–	–	+	+	+	+	+	–	*alipentus**
5	–	–	+	+	+	+	+	–	*pentus**
5	–	–	–	+	+	+	+	+	*obscurus**
5	–	–	–	+	+	+	+	+	*peringueyi*
5	–	–	–	+	+	+	+	+	*braunsi*
5	–	–	–	+	+	+	+	+	*klopperi*
5	–	–	–	+	+	+	+	+	*stuckenbergi*
6	–	+	+	+	+	+	+	–	*benhami*
6	–	+	+	+	+	+	+	–	*mkuzi*
6	–	–	+	+	+	+	+	+	*pauli**
6	–	–	+	+	+	+	+	+	*imitatus**
6	–	–	+	+	+	+	+	+	*senarius**

Microchaetus zaloumisi Plisko, 1992

Microchaetus zaloumisi Plisko, 1992: 352.
Microchaetus zaloumisi; Reynolds & Cook 1993: 22.

Material examined: **KwaZulu-Natal**: Vernon Crookes Nature Reserve (30°16'S:30°35'E), forest area near tourist camp, from moist soil, 1 clitellate, 1 abscised anterior part, NMSA/Olig.00378; 5 km W tourist camp, dug from black soil at depth of *ca.* 45 cm, 2 clitellate NMSA/Olig.00827 and 1 with no clitellum NMSA/Olig.00829; forest at left side of rustic camp, under fallen leaves, 2 clitellate NMSA/Olig.00833. All material collected 8 March 1989 by JDP.

TABLE 2

Microchaetus species arranged according to selected characters. **Seminal vesicles**: n.v = number of pairs; ext. = extended pair; anterior = extended anterior pair; posterior = extended posterior pair; n.ext. = not extended. **Spermathecae**: n.rows = number of rows; P = paired; M = multiple. **Calciferous glands** (Calc.glands): e = encircling oesophagus; p = paired glands. **Dorsal blood vessel** (DBV): u = undivided in anterior segments; d = doubled in some anterior segments. **Nephridia**: V = V-shaped caeca; J = J-shaped caeca.

Marked with an asterisk = metandric (one pair of testes in segment 11, and one pair of spermiductal funnels commencing in 11). All other species holandric (two pairs of testes in segments 10 and 11 respectively, and two pairs funnels commencing in segments 10 and 11).

Species name	**Seminal vesicles**			**Spermathecae**		**Calc. glands**		**DBV**		**Nephridia**	
	n.ext.	ext.	n.v	n.rows	P M	enc.	paired	u	d	V	J
*metandrus**	–	posterior	1	3	P	–	p	u	–	–	?J
pearsonianus	–	posterior	1	3	M	e	–	u	–	–	J
ljungströmi	–	posterior	2	3	P	–	p	u	–	?F	?
occidualis	–	posterior	2	3	M	–	p	u	–	–	?J
occiduus	–	posterior	2	3	M	–	p	u	–	–	?J
rosai	–	posterior	2	4	P	e	–	u	–	–	J
hamerae	–	posterior	2	4	P	–	p	u	–	–	J
obscurus	–	posterior	2	5	M	–	p	u	–	–	J
pentus	–	posterior	2	5	M	–	p	u	–	–	J
senarius	–	posterior	2	6	M	–	p	u	–	–	J
imitatus	–	posterior	1	6	M	–	p	u	–	–	J
alipentus	–	anterior	1	5	M	–	p	u	–	–	J
pauli	–	anterior	1	6	M	–	p	u	–	–	J
zaloumisi	not ext.	–	2	1	M	–	p	–	d	V	–
pondoanus	not ext.	–	2	1	M	–	p	–	d	V	–
parvus	not ext.	–	2	2	P	–	p	–	d	V	–
rivus	not ext.	–	2	2	P	–	p	–	d	V	–
natalensis	not ext.	–	2	2	M	–	p	–	d	V	–
tuberosus	not ext.	–	2	2	M	–	p	–	d	V	–
montanus	not ext.	–	2	2	M	–	p	–	d	V	–
pentheri	not ext.	–	2	2	M	–	p	–	d	V	–
ritae	not ext.	–	2	2	M	–	p	–	d	V	–
caementerii	not ext.	–	2	2	M	–	p	–	d	V	–
guntheri	not ext.	–	2	3	M	e	–	u	–	–	J
franciscus	not ext.	–	2	3	M	–	p	u	–	–	J
ambitus	not ext.	–	2	3	M	e	–	–	d	V	–
vernoni	not ext.	–	2	3	M	e	–	–	d	V	–
decipiens	not ext.	–	2	3	M	e	–	–	d	V	–
madidus	not ext.	–	2	3	M	–	p	–	d	V	–
namaensis	not ext.	–	2	3	M	e	–	–	d	?	?
circulatus	not ext.	–	2	4	P	e	–	u	–	–	J
crousi	not ext.	–	2	4	M	e	–	u	–	?	?J
papillatus	not ext.	–	2	4	M	e	–	–	d	V	–
microchaetus	not ext.	–	2	4	M	e	–	–	d	V	–
davidi	not ext.	–	2	4	M	–	p	u	–	–	J
stuckenbergi	not ext.	–	2	4	M	–	p	–	d	V	–
braunsi	not ext.	–	2	5	M	e	–	–	d	V	–
peringueyi	not ext.	–	2	5	M	e	–	u	–	–	?
klopperi	not ext.	–	2	5	M	–	p	–	d	V	–
mkuzi	not ext.	–	2	6	P	e	–	–	d	V	–
benhami	not ext.	–	2	6	P	e	–	u	–	V	–

The description of the holotype matches this previously unstudied material, with the exception of the number of spermathecae. In the above material, spermathecae were found deeply embedded in the body tissue. The number of ampullae varies from 3–4 on each side — not 5 as stated in the original description. It is possible, that in

the above material some of the spermathecae were not visible, being embedded in thick muscles of the body wall. Oesophageal vessels are present in this species, though this was not noted in the original description.

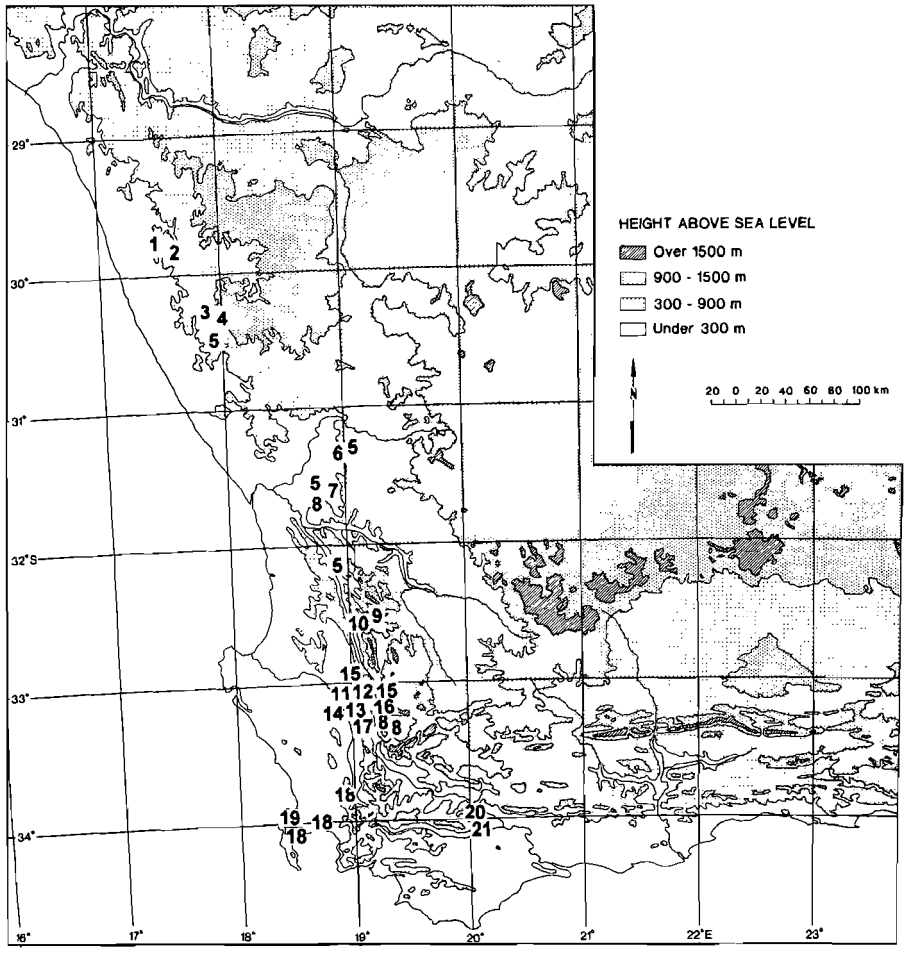


Fig. 33. Map of south-western and western South Africa, showing distribution of species of *Microchaetus*. Species names: 1 = *namaensis**; 2 = *rosai**; 3 = *davidi*; 4 = *circulatus*; 5 = *hamerae*; 6 = *peringueyi**; 7= *pauli*; 8 = *occiduus*; 9 = *pentus*; 10 = *alipentus*; 11 = *occidualis*; 12 = *imitatus*; 13 = *obscurus*; 14 = *senarius*; 15 = *metandrus*; 16 = *ljungströmi**; 17 = *guntheri**; 18 = *benhami**; 19 = *pearsonianus**; 20 = *franciscus**; 21 = *crousi**. For distribution of the other 20 *Microchaetus* species in eastern South Africa see Fig. 34. * = species known from the literature; the others = species described in this paper.

DISCUSSION

Certain characters important in the recognition of species of *Microchaetus* have been found to occur in different states and combinations. They are listed in Tables 1 and 2, which may be used as supplements to the key to species.

Six groups of species can be distinguished according to the number of intersegmental furrows with spermathecal pores (Table 1). In each of these groups,

while the number of intersegmental furrows is the same in all included species, specific differences exist in the numerical sequence of furrows, which have pores. In some species the series of furrows may be partly anterior or partly posterior relative to the majority of species in a group. In over 92 % (38 species) spermathecal pores occur in intersegmental furrow 13/14, and this condition therefore is highly typical of holandric species. (In *Proandricus,* spermathecal pores occur in 92 % of species in intersegmental furrow 12/13 (Plisko 1993*b*)). Spermathecae are paired or multiple. Nine species have paired spermathecae (*metandrus, ljungströmi, rosai, hamerae, parvus, rivus, circulatus, mkuzi, benhami*). Multiple spermathecae occur in the other 32 species (Tables 2 and 3); the number of spermathecae occurring on each side varies from 1–16.

The holandric condition is characteristic in *Microchaetus* as it occurs in all species except *metandrus*, in which metandry is evidently a cladistically recent secondary condition. This is shown by other features of *metandrus* that clearly link it to holandric species in the NW and SW Cape. It should be also stressed that a group of four species (*alipentus, imitatus, pauli* and *pearsonianus*) known from the same geographical region, with a typical holandric condition, manifest incipient metandry (reduction of one pair of seminal vesicles), at the same time sharing the other character states of *Microchaetus*. Pickford (1975) observed in selected individuals of *pearsonianus* a loss of the anterior pair of spermiductal funnels.

A majority of species (28) has two pairs of testes, two pairs of spermiductal funnels, and seminal vesicles confined to segments 11 and 12. Backward extension of one pair of seminal vesicles was observed in 13 species. The posterior pair is extended in 11 of these (*metandrus, pearsonianus, ljungströmi, occidualis, occiduus, rosai, hamerae, obscurus, pentus, imitatus, senarius).* The anterior pair is extended in *alipentus* and *pauli.* All of backward extension was occurring only in species from Northern and Western Cape.

Paired calciferous glands occur in 26 species; in the other 15 species these glands encircle the oesophagus. It should be emphasised, however, that a distinction between bilobed swellings encircling the oesophagus and paired glands is always difficult to establish; even if the gland appears externally to be single, its internal structure reflects a paired origin (Pickford 1975).

Thirteen species have J-shaped nephridial caeca, and in 21 species the caeca are V-shaped (in 7 species the shape could not definitely be determined). Nephridia were observed mainly in the clitellar segments; not much is known of their variability in the anterior and posterior segments. The details of nephridial structure are poorly known in all microchaetids, and histological studies are needed.

The dorsal blood vessel was found to be undivided over its entire length in 20 species, and to be doubled in some anterior segments in another 21 species. When double, the two vessels lie close together in all or some of segments 4–7, sometimes being slightly separated. More distant separation of two vessels occurs usually in segment 8. In segment 9 both vessels unite in a cordiform organ; this organ was also seen in some species with an undivided dorsal blood vessel. According to Stephenson (1930) the double condition of the dorsal blood vessel is a remnant of an embryonic state, occurring when the two longitudinal blood channels fail to fuse completely.

TABLE 3

Microchaetus species arranged according to geographical distribution, with indication of selected anatomical characters. **Spermathecae**: n.rows = number of rows; P = paired; M = multiple. **Seminal vesicles**: extend. = one of pair extended backward; not extend. = seminal vesicles not extended backward. **Nephridia**: J = J-shaped caeca; V = V-shaped caeca. EC = Eastern Cape; KZN = KwaZulu-Natal; Mp. = Mpumalanga; NP. = Northern Province.

Species name	**Spermathecae**			**Seminal vesicles**		**Nephridia**		Region
	n.rows	P	M	extend.	not extend.	J	V	
namaensis	3	–	M	–	+	?	?	Northern Cape
rosai	4	P	–	+	–	J	–	Northern Cape
davidi	4	–	M	–	+	J	–	Northern Cape
circulatus	4	P	–	–	+	J	–	Northern Cape
hamerae	4	P	–	+	–	J	–	Western Cape
peringueyi	5	–	M	–	+	?	?	Western Cape
pauli	6	–	M	+	–	J	–	Western Cape
occidualis	3	–	M	+	–	J?	–	Western Cape
obscurus	5	–	M	+	–	J	–	Western Cape
pentus	5	–	M	+	–	J	–	Western Cape
alipentus	5	–	M	+	–	J	–	Western Cape
senarius	6	–	M	+	–	J	–	Western Cape
imitatus	6	–	M	+	–	J	–	Western Cape
*metandrus**	3	P	–	+	–	J?	–	Western Cape
occiduus	3	–	M	+	–	J?	–	Western Cape
ljungströmi	3	P	–	+	–	J?	V?	Western Cape
guntheri	3	–	M	–	+	J	–	Western Cape
benhami	6	P	–	–	+	–	V	Western Cape
pearsonianus	3	–	M	+	–	J	–	Western Cape
franciscus	3	–	M	–	+	J	–	Western Cape
crousi	4	–	M	–	+	J?	V?	Western Cape
microchaetus	4	–	M	–	+	–	V	Eastern Cape
braunsi	5	–	M	–	+	–	V	Eastern Cape
decipiens	3	–	M	–	+	–	V	Eastern Cape
pentheri	2	–	M	–	+	–	V	Eastern Cape
klopperi	5	–	M	–	+	–	V	Eastern Cape
ritae	2	–	M	–	+	–	V	Eastern Cape
stuckenbergi	5	–	M	–	+	–	V	Eastern Cape
madidus	3	–	M	–	+	–	V	Eastern Cape
montanus	2	–	M	–	+	–	V	Eastern Cape
rivus	2	P	–	–	+	–	V	Eastern Cape
pondoanus	1	–	M	–	+	–	V	EC, south KZN
zaloumisi	1	–	M	–	+	–	V	KwaZulu-Natal
tuberosus	2	–	M	–	+	–	V	KwaZulu-Natal
ambitus	3	–	M	–	+	–	V	KwaZulu-Natal
vernoni	3	–	M	–	+	–	V	KwaZulu-Natal
parvus	2	P	–	–	+	–	V	KZN, Mp.
papillatus	4	–	M	–	+	–	V	KwaZulu-Natal
caementerii	2	–	M	–	+	–	V	KwaZulu-Natal
mkuzi	6	P	–	–	+	–	V	KwaZulu-Natal
natalensis	2	–	M	–	+	–	V	KZN, Mp. NP. Swaziland

Some of the morphological features described above may be of importance for phylogenetic inference. In various combinations of character states as set out in Tables 1 and 2, they appear to distinguish groups of species, which are geographically distinctive. J-shaped nephridial caeca together with backward extension of seminal vesicles were found only in species from western parts of southern Africa (Table 3). Species with a partially divided dorsal blood vessel occur mostly in eastern regions.

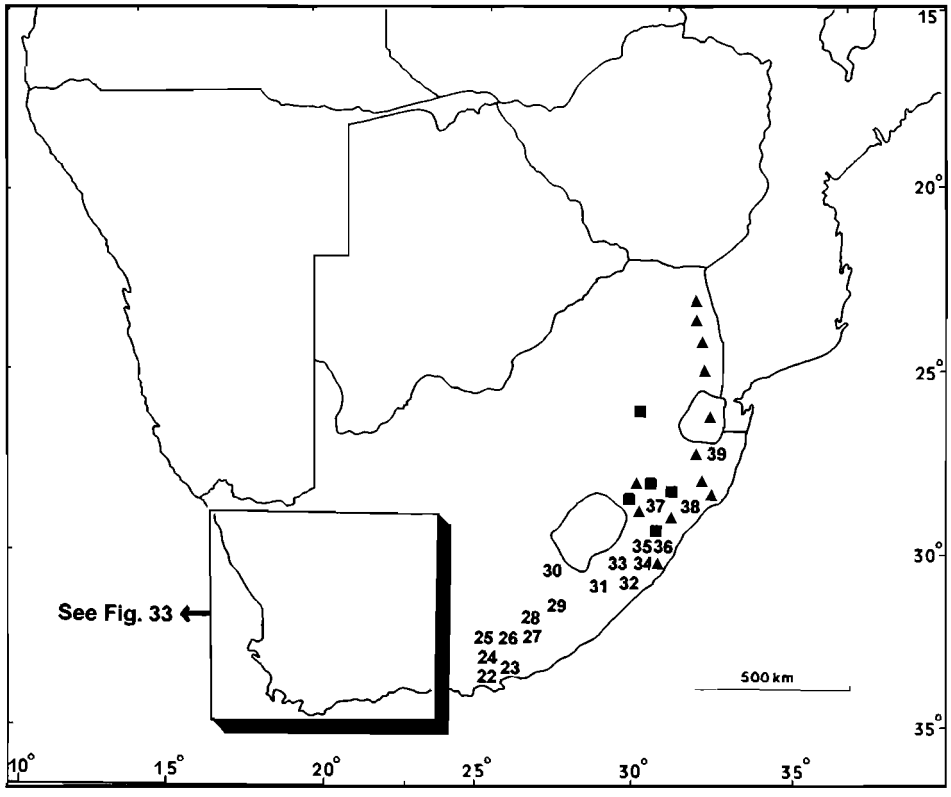


Fig. 34. Map of South Africa, showing distribution of species of *Microchaetus* in eastern provinces. Species names: 22 = *microchaetus*; 23 = *braunsi*; 24 = *decipiens*; 25 = pentheri; 26 = *klopperi*; 27 = *ritae*; 28 = *stuckenbergi*; 29 = *madidus*; 30 = *montanus*; 32 = *pondoanus*; 33 = *tuberosus*; 34 = *vernoni*; 35 = *zaloumisi*; 36 = *ambitus*; 37 = *caementerii*; 38 = *papillatus*; 39 = *mkuzi*; ■ = *parvus*; ▲ = *natalensis*. For the distribution of the other 21 species in the south-western part of the country see Fig. 33.

Representatives of *Microchaetus* are recorded from much of South Africa, being absent only from very dry areas inhospitable to all earthworms. The main concentration of species (21) occurs in the Namaqualand and south-western Cape (Fig. 33). The other 20 species occur in the eastern part of the country (Fig. 34). In the Eastern Cape 12 species have been found. Despite much collecting effort, only 8 species are known in KwaZulu-Natal, of which *M. natalensis* (Kinberg, 1867) ranges into parts of Swaziland (Reynolds 1993) and probably Mozambique. *M. natalensis* is also found along the northern section of the Drakensberg escarpment, providing the only record of the genus in the Kruger National Park. *M. parvus* Michaelsen, 1913*c* is tolerant of disturbance and has been collected in cultivated fields, so may have been introduced to some localities. In the Drakensberg range of KwaZulu-Natal only *M. montanus* Plisko, 1993*b* has been found, but this may be due to incomplete collecting; it is notable that *Tritogenia* may also be poorly represented (or even absent) in the Drakensberg (Plisko 1997). In contrast, *Proandricus* is represented in

KwaZulu-Natal by 12 species of which 5 are known from the Drakensberg (Plisko 1992 1993*a* 1996).

Certain combinations of character states can now be seen to distinguish some clusters of species, which are broadly restricted to particular regions of South Africa (Table 3). This provides new insights into possible patterns of cladogenesis in the genus. A biogeographical understanding of *Microchaetus* is beginning to emerge.

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